

data_analysis

July 15, 2025

```
[13]: import pandas as pd
      from sklearn.model_selection import train_test_split
      import joblib
      import numpy as np
      from sklearn.feature_selection import VarianceThreshold, SelectKBest, f_classif
```

```
[14]: # Show all columns in the DataFrame
      pd.set_option('display.max_columns', None)
      pd.set_option('display.width', None)
```

```
[15]: # Load raw data
      #benign = pd.read_csv('datasets/hmi_normal_6h_flow_label.csv')
      scapy_modify = pd.read_csv('datasets/mitm_hmi_scapy_modify_1plc_6h_flow_label.
      ↪csv')
      fw_36plc = pd.read_csv('datasets/mitm_hmi_forward_36plc_6h_flow_label.csv')
```

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[16]: scapy_modify.groupby("Label").describe()
```

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[16]:
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	Src Port											
	count	mean	std	min	25%	50%						
Label												
mitm	6754.0	45706.734972	5553.484326	32784.0	44818.0	44818.0						
normal	164457.0	45785.487161	5607.404711	32768.0	44818.0	44818.0						

	Dst Port											
	75%	max	count	mean	std	min						
Label												
mitm	45037.0	60992.0	6754.0	45878.698253	6111.837581	32784.0						
normal	45764.0	60998.0	164457.0	45946.057510	6071.042539	32768.0						

	Protocol											
	25%	50%	75%	max	count	mean	std	min	25%	50%		
Label												
mitm	44818.0	44818.0	47685.5	60992.0	6754.0	6.0	0.0	6.0	6.0	6.0		
normal	44818.0	44818.0	48036.0	60998.0	164457.0	6.0	0.0	6.0	6.0	6.0		

	Flow Duration													
	75%	max	count	mean	std	min	25%							
Label														

Label								
mitm	6.0	6.0	6754.0	434630.275540	1.566391e+06	14.0	35.0	
normal	6.0	6.0	164457.0	58148.334805	1.424615e+06	7.0	14.0	

				Tot Fwd Pkts				
	50%	75%		max	count	mean	std	
Label								
mitm	616202.5	792774.25	99088176.0		6754.0	2.449067	2.457426	
normal	57859.0	73380.00	117511126.0		164457.0	2.459804	2.466897	

						Tot Bwd Pkts				
	min	25%	50%	75%	max	count	mean	std	min	25%
Label										
mitm	0.0	0.0	4.0	5.0	6.0	6754.0	3.553154	1.569620	1.0	2.0
normal	0.0	0.0	4.0	5.0	6.0	164457.0	3.541515	1.553819	2.0	2.0

						TotLen Fwd Pkts					
	50%	75%	max			count	mean	std	min	25%	50%
Label											
mitm	5.0	5.0	8.0			6754.0	47.787385	48.099579	0.0	0.0	72.0
normal	5.0	5.0	8.0			164457.0	47.981515	48.193465	0.0	0.0	72.0

						TotLen Bwd Pkts					
	75%	max				count	mean	std	min	25%	50%
Label											
mitm	98.0	168.0				6754.0	38.269174	38.660947	0.0	0.0	72.0
normal	96.0	100.0				164457.0	38.461665	38.756286	0.0	0.0	72.0

						Fwd Pkt Len Max					
	75%	max				count	mean	std	min	25%	50%
Label											
mitm	72.0	100.0				6754.0	33.752147	34.166059	0.0	0.0	44.0
normal	78.0	100.0				164457.0	33.978535	34.284204	0.0	0.0	44.0

						Fwd Pkt Len Min							
	75%	max				count	mean	std	min	25%	50%	75%	max
Label													
mitm	70.0	72.0				6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	68.0	72.0				164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

						Fwd Pkt Len Mean							
						count	mean	std	min	25%	50%	75%	max
Label													
mitm						6754.0	9.749585	9.755739	0.0	0.0	18.0	19.6	28.0
normal						164457.0	9.749339	9.753269	0.0	0.0	18.0	19.2	20.0

						Fwd Pkt Len Std		
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	count	mean	std	min	25%	50%	75%
Label							
mitm	6754.0	14.920295	15.028194	0.0	0.0	21.786846	30.672463
normal	164457.0	14.990621	15.069873	0.0	0.0	21.786846	29.852973

	Bwd Pkt Len Max								
	max	count	mean	std	min	25%	50%	75%	
Label									
mitm	34.292856	6754.0	24.265028	24.886134	0.0	0.0	44.0	44.0	
normal	31.496031	164457.0	24.458685	24.926832	0.0	0.0	44.0	50.0	

	Bwd Pkt Len Min								
	max	count	mean	std	min	25%	50%	75%	max
Label									
mitm	72.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	72.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Bwd Pkt Len Mean							
	count	mean	std	min	25%	50%	75%	
Label								
mitm	6754.0	7.480942	7.496550	0.0	0.0	12.375	14.4	
normal	164457.0	7.558702	7.572162	0.0	0.0	12.000	15.6	

	Bwd Pkt Len Std							
	max	count	mean	std	min	25%	50%	
Label								
mitm	16.666667	6754.0	11.012655	11.146532	0.0	0.0	20.51341	
normal	16.666667	164457.0	11.102558	11.203735	0.0	0.0	20.51341	

	Flow Byts/s							
	75%	max	count	mean	std	min	25%	
Label								
mitm	20.513410	29.330303	6754.0	106.448680	107.724388	0.0	0.0	
normal	22.733236	29.330303	164457.0	1164.924351	1180.243370	0.0	0.0	

	Flow Pkts/s						
	50%	75%	max	count	mean		
Label							
mitm	1.992790	216.632122	338.550777	6754.0	35418.533351		
normal	1.803155	2355.486778	3057.083121	164457.0	71186.095216		

	std	min	25%	50%	75%
Label					
mitm	39916.649455	0.121104	12.613931	16.231172	57142.857143
normal	78249.038332	0.102118	136.278772	172.962502	142857.142857

	Flow IAT Mean \					
	max	count	mean	std	min	25%
Label						
mitm	142857.142857	6754.0	47810.307408	144692.168035	14.0	35.0
normal	285714.285714	164457.0	6053.155641	129522.082678	7.0	14.0

	Flow IAT Std \				
	50%	75%	max	count	mean
Label					
mitm	69502.5	88088.583333	9.008016e+06	6754.0	61929.003762
normal	6424.0	8153.222222	1.068283e+07	164457.0	13498.581455

	\					
	std	min	25%	50%	75%	max
Label						
mitm	455455.016393	0.0	0.0	75823.085052	105804.078147	2.963342e+07
normal	429158.498273	0.0	0.0	11627.964869	13719.697409	3.540754e+07

	Flow IAT Max \					
	count	mean	std	min	25%	50%
Label						
mitm	6754.0	165512.691146	1.508231e+06	14.0	35.0	194066.0
normal	164457.0	43585.339639	1.423458e+06	7.0	14.0	36986.0

	Flow IAT Min \					
	75%	max	count	mean	std	min
Label						
mitm	276949.75	98355743.0	6754.0	63.708617	1664.419176	13.0
normal	43238.00	117440559.0	164457.0	16.784807	9.151835	4.0

	Fwd IAT Tot \						
	25%	50%	75%	max	count	mean	std
Label							
mitm	20.0	29.0	38.0	100501.0	6754.0	314562.587060	315999.420297
normal	11.0	14.0	22.0	2064.0	164457.0	34062.665639	34647.273340

	Fwd IAT Mean \						
	min	25%	50%	75%	max	count	mean
Label							
mitm	0.0	0.0	470988.5	628555.0	776518.0	6754.0	81354.608528
normal	0.0	0.0	50543.0	66317.0	156975.0	164457.0	8727.146386

	Fwd IAT Std \							
	std	min	25%	50%	75%	max	count	
Label								
mitm	82457.804395	0.0	0.0	118766.25	158968.375	252569.00	6754.0	
normal	8898.843536	0.0	0.0	13176.00	16922.000	39243.75	164457.0	

	mean	std	min	25%	50%	75%
Label						
mitm	74244.508187	75455.695403	0.0	0.0	65767.341155	151067.292561
normal	10256.294977	10501.460605	0.0	0.0	14713.764316	19285.950368

	Fwd IAT Max					
	max	count	mean	std	min	25%
Label						
mitm	201558.904417	6754.0	154264.025318	155730.636886	0.0	0.0
normal	68549.944913	164457.0	23079.325629	23513.684397	0.0	0.0

	Fwd IAT Min					
	50%	75%	max	count	mean	std
Label						
mitm	204687.0	307223.25	438777.0	6754.0	6640.931744	18928.241434
normal	37016.0	43284.00	141872.0	164457.0	1221.682902	1431.210742

	Bwd IAT Tot						
	min	25%	50%	75%	max	count	mean
Label							
mitm	0.0	0.0	1958.0	6095.25	135708.0	6754.0	431217.406574
normal	0.0	0.0	1239.0	2082.00	19406.0	164457.0	55162.797917

	std	min	25%	50%	75%	max
Label						
mitm	1.565578e+06	0.0	35.0	609929.0	785992.25	99088176.0
normal	1.424580e+06	7.0	14.0	54144.0	67067.00	117511126.0

	Bwd IAT Mean						
	count	mean	std	min	25%	50%	
Label							
mitm	6754.0	102895.405747	237557.336597	0.0	35.0	126171.9	
normal	164457.0	11443.127877	203580.924270	7.0	14.0	11946.6	

	Bwd IAT Std					
	75%	max	count	mean	std	
Label						
mitm	194004.9125	1.415545e+07	6754.0	60112.545143	569092.745766	
normal	16542.2500	1.678730e+07	164457.0	17682.778109	537956.338481	

	Bwd IAT Max				
	min	25%	50%	75%	max
Label					
mitm	0.0	0.0	57030.169689	98073.563059	3.712901e+07
					count
					6754.0

normal	0.0	0.0	14333.896201	18761.503636	4.438392e+07	164457.0
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		mean	std	min	25%	50%	75%
Label							
mitm	173616.759994	1.508831e+06	0.0	35.0	213070.0	293905.25	
normal	43794.498726	1.423459e+06	7.0	14.0	37471.0	43664.00	

		Bwd IAT Min						
		max	count	mean	std	min	25%	50%
Label								
mitm	98355743.0	6754.0	38636.816849	43667.114064	0.0	35.0	105.5	
normal	117440559.0	164457.0	1716.652025	2087.730052	7.0	14.0	103.0	

		Fwd PSH Flags									
		75%	max	count	mean	std	min	25%	50%	75%	max
Label											
mitm	81205.25	151454.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	3182.00	13849.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		Bwd PSH Flags						Fwd URG Flags			
		count	mean	std	min	25%	50%	75%	max	count	mean
Label											
mitm	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	0.0	
normal	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	0.0	

		Bwd URG Flags											
		std	min	25%	50%	75%	max	count	mean	std	min	25%	50%
Label													
mitm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0	0.0	0.0
normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0	0.0	0.0

		Fwd Header Len									
		75%	max	count	mean	std	min	25%	50%	75%	
Label											
mitm	0.0	0.0	6754.0	78.790643	78.922803	0.0	0.0	136.0	160.0		
normal	0.0	0.0	164457.0	79.039846	79.159871	0.0	0.0	136.0	160.0		

		Bwd Header Len								
		max	count	mean	std	min	25%	50%	75%	
Label										
mitm	192.0	6754.0	121.288126	57.548323	44.0	64.0	176.0	176.0		
normal	192.0	164457.0	121.004080	57.193933	64.0	64.0	176.0	176.0		

		Fwd Pkts/s							
		max	count	mean	std	min	25%	50%	75%
Label									

mitm	264.0	6754.0	3.035348	3.084742	0.0	0.0	3.770851	6.213025
normal	264.0	164457.0	33.152261	33.689838	0.0	0.0	0.041677	67.281168

Bwd Pkts/s								
	max	count	mean	std	min	25%		
Label								
mitm	15.614265	6754.0	35415.498003	39919.342230	0.080736	6.368036		
normal	96.677516	164457.0	71152.942954	78279.141975	0.068079	68.809865		

Pkt Len Min								
	50%	75%	max	count	mean	std	min	
Label								
mitm	9.511096	57142.857143	142857.142857	6754.0	0.0	0.0	0.0	
normal	100.446989	142857.142857	285714.285714	164457.0	0.0	0.0	0.0	

Pkt Len Max										
	25%	50%	75%	max	count	mean	std	min	25%	50%
Label										
mitm	0.0	0.0	0.0	0.0	6754.0	35.010364	35.021639	0.0	0.0	68.0
normal	0.0	0.0	0.0	0.0	164457.0	34.897913	34.918514	0.0	0.0	66.0

Pkt Len Mean										
	75%	max	count	mean	std	min	25%	50%		
Label										
mitm	70.0	72.0	6754.0	7.821808	7.821432	0.0	0.0	13.153846		
normal	68.0	72.0	164457.0	7.857901	7.856737	0.0	0.0	13.384615		

Pkt Len Std									
	75%	max	count	mean	std	min	25%		
Label									
mitm	15.636364	20.000000	6754.0	12.154557	12.152875	0.0	0.0		
normal	15.636364	15.818182	164457.0	12.197651	12.195516	0.0	0.0		

Pkt Len Var								
	50%	75%	max	count	mean	std		
Label								
mitm	22.905756	24.371369	27.804512	6754.0	295.403750	295.439760		
normal	23.027297	24.371369	24.491928	164457.0	297.512394	297.490619		

FIN Flag Cnt								
	min	25%	50%	75%	max	count	mean	
Label								
mitm	0.0	0.0	524.717949	593.963636	773.090909	6754.0	0.499704	
normal	0.0	0.0	530.256410	593.963636	599.854545	164457.0	0.500106	

SYN Flag Cnt									
	std	min	25%	50%	75%	max	count	mean	std
Label									

Label									
mitm	0.500037	0.0	0.0	0.0	1.0	1.0	6754.0	0.499852	0.500037
normal	0.500002	0.0	0.0	1.0	1.0	1.0	164457.0	0.499894	0.500002

	RST Flag Cnt \											
	min	25%	50%	75%	max	count	mean	std	min	25%	50%	75%
Label												
mitm	0.0	0.0	0.0	1.0	1.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	0.0	0.0	0.0	1.0	1.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0

[illegible]

Label								URG Flag Cnt		
	mean	std	min	25%	50%	75%	max	count	mean	std
mitm	0.500148	0.500037	0.0	0.0	1.0	1.0	1.0	6754.0	0.0	0.0
normal	0.500106	0.500002	0.0	0.0	1.0	1.0	1.0	164457.0	0.0	0.0

Label	CWE Flag Count					\							
	min	25%	50%	75%	max	count	mean	std	min	25%	50%	75%	
mitm	0.0	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	
normal	0.0	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	

	ECE Flag Cnt								Down/Up Ratio \
Label	max	count	mean	std	min	25%	50%	75%	max count
mitm	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0
normal	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0

	Pkt Size Avg								
	mean	std	min	25%	50%	75%	max	count	mean
Label									
mitm	0.500444	0.500629	0.0	0.0	1.0	1.0	2.0	6754.0	8.603843
normal	0.500283	0.500427	0.0	0.0	1.0	1.0	2.0	164457.0	8.643638

	Fwd Seg						Size Avg	
	std	min	25%	50%	75%	max	count	mean
Label								
mitm	8.603407	0.0	0.0	14.25	17.2	21.818182	6754.0	9.749585
normal	8.642374	0.0	0.0	14.50	17.2	17.400000	164457.0	9.749339

Bwd Seg Size Avg \

	std	min	25%	50%	75%	max	count	mean	
Label									
mitm	9.755739	0.0	0.0	18.0	19.6	28.0	6754.0	7.480942	
normal	9.753269	0.0	0.0	18.0	19.2	20.0	164457.0	7.558702	

	std	min	25%	50%	75%	max	Fwd Byts/b Avg	count	mean	std	
Label											
mitm	7.496550	0.0	0.0	12.375	14.4	16.666667	6754.0	0.0	0.0		
normal	7.572162	0.0	0.0	12.000	15.6	16.666667	164457.0	0.0	0.0		

	min	25%	50%	75%	max	Fwd Pkts/b Avg	count	mean	std	min	25%	50%	75%	
Label														
mitm	0.0	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
normal	0.0	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	max	Fwd Blk Rate Avg	count	mean	std	min	25%	50%	75%	max	
Label											
mitm	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
normal	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	count	mean	std	min	25%	50%	75%	max	Bwd Byts/b Avg	count	mean	
Label												
mitm	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	0.0		
normal	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	0.0		

	std	min	25%	50%	75%	max	Bwd Blk Rate Avg	count	mean	std	min	25%	
Label													
mitm	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	
normal	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	

	50%	75%	max	Subflow Fwd Pkts	count	mean	std	min	25%	50%	
Label											
mitm	0.0	0.0	0.0	6754.0	2.449067	2.457426	0.0	0.0	4.0		
normal	0.0	0.0	0.0	164457.0	2.459804	2.466897	0.0	0.0	4.0		

	75%	max	Subflow Fwd Byts	count	mean	std	min	25%	50%	75%	
Label											
mitm	5.0	6.0	6754.0	47.787385	48.099579	0.0	0.0	72.0	98.0		
normal	5.0	6.0	164457.0	47.981515	48.193465	0.0	0.0	72.0	96.0		

	Subflow Bwd Pkts \								
Label	max	count	mean	std	min	25%	50%	75%	max
mitm	168.0	6754.0	3.553154	1.569620	1.0	2.0	5.0	5.0	8.0
normal	100.0	164457.0	3.541515	1.553819	2.0	2.0	5.0	5.0	8.0

	Subflow Bwd Byts \								
Label	count	mean	std	min	25%	50%	75%	max	
mitm	6754.0	38.269174	38.660947	0.0	0.0	72.0	72.0	100.0	
normal	164457.0	38.461665	38.756286	0.0	0.0	72.0	78.0	100.0	

	Init Fwd Win Byts									Init Bwd Win Byts \	
Label	count	mean	std	min	25%	50%	75%	max	count		
mitm	6754.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	6754.0		
normal	164457.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	164457.0		

	Fwd Act Data Pkts \								
Label	mean	std	min	25%	50%	75%	max	count	
mitm	83.896062	0.994657	83.0	83.0	83.0	85.0	85.0	6754.0	
normal	83.918684	0.996691	83.0	83.0	83.0	85.0	85.0	164457.0	

	Fwd Seg Size Min \								
Label	mean	std	min	25%	50%	75%	max	count	mean
mitm	1.000740	1.000740	0.0	0.0	2.0	2.0	3.0	6754.0	0.0
normal	1.000213	1.000003	0.0	0.0	2.0	2.0	2.0	164457.0	0.0

	Active Mean \										
Label	std	min	25%	50%	75%	max	count	mean	std	min	
mitm	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	0.008884	0.549823	0.0	
normal	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	0.003867	0.287735	0.0	

	Active Std \												
Label	25%	50%	75%	max	count	mean	std	min	25%	50%	75%	max	
mitm	0.0	0.0	0.0	41.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
normal	0.0	0.0	0.0	36.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	Active Max									Active Min \	
Label	count	mean	std	min	25%	50%	75%	max	count		
mitm	6754.0	0.008884	0.549823	0.0	0.0	0.0	0.0	41.0	6754.0		
normal	164457.0	0.003867	0.287735	0.0	0.0	0.0	0.0	36.0	164457.0		

	mean	std	min	25%	50%	75%	max	Idle Mean count	\ mean
Label									
mitm	0.008884	0.549823	0.0	0.0	0.0	0.0	41.0	6754.0	25647.077584
normal	0.003867	0.287735	0.0	0.0	0.0	0.0	36.0	164457.0	20526.033231

		std	min	25%	50%	75%	max	Idle Std count	\ mean	std
Label										
mitm	1.503937e+06	0.0	0.0	0.0	0.0	0.0	98355743.0	6754.0	0.0	0.0
normal	1.423597e+06	0.0	0.0	0.0	0.0	0.0	117440559.0	164457.0	0.0	0.0

	min	25%	50%	75%	max	Idle Max count	mean	std	min
Label									
mitm	0.0	0.0	0.0	0.0	0.0	6754.0	25647.077584	1.503937e+06	0.0
normal	0.0	0.0	0.0	0.0	0.0	164457.0	20526.033231	1.423597e+06	0.0

	25%	50%	75%	max	Idle Min count	mean	std	min
Label								
mitm	0.0	0.0	0.0	98355743.0	6754.0	25647.077584	1.503937e+06	0.0
normal	0.0	0.0	0.0	117440559.0	164457.0	20526.033231	1.423597e+06	0.0

	25%	50%	75%	max
Label				
mitm	0.0	0.0	0.0	98355743.0
normal	0.0	0.0	0.0	117440559.0

```
[17]: fw_36plc['Label'].unique()
```

```
[17]: array(['mitm'], dtype=object)
```

```
[18]: fw_36plc['Label'] = 'mitm_36plc'
```

```
[19]: # Drop unnecessary columns
cols_to_drop = ['Flow ID', 'Src IP', 'Src Port', 'Dst IP', 'Dst Port',
↳ 'Timestamp']
#benign.drop(columns=cols_to_drop, errors='ignore', inplace=True)
scapy_modify.drop(columns=cols_to_drop, errors='ignore', inplace=True)
fw_36plc.drop(columns=cols_to_drop, errors='ignore', inplace=True)
```

```
[20]: # Merge
df = pd.concat([scapy_modify, fw_36plc], ignore_index=True)
```

```
[21]: df.groupby("Label").describe()
```

```
[21]:
```

	Protocol								Flow Duration \
	count	mean	std	min	25%	50%	75%	max	count
Label									
mitm	6754.0	6.0	0.0	6.0	6.0	6.0	6.0	6.0	6754.0
mitm_36plc	188383.0	6.0	0.0	6.0	6.0	6.0	6.0	6.0	188383.0
normal	164457.0	6.0	0.0	6.0	6.0	6.0	6.0	6.0	164457.0

	mean	std	min	25%	50%	75%
Label						
mitm	434630.275540	1.566391e+06	14.0	35.0	616202.5	792774.25
mitm_36plc	65592.658149	1.536137e+06	5.0	11.0	60558.0	78157.50
normal	58148.334805	1.424615e+06	7.0	14.0	57859.0	73380.00

	Tot Fwd Pkts							
	max	count	mean	std	min	25%	50%	75%
Label								
mitm	99088176.0	6754.0	2.449067	2.457426	0.0	0.0	4.0	5.0
mitm_36plc	119999986.0	188383.0	2.456639	2.464104	0.0	0.0	4.0	5.0
normal	117511126.0	164457.0	2.459804	2.466897	0.0	0.0	4.0	5.0

	Tot Bwd Pkts								
	max	count	mean	std	min	25%	50%	75%	max
Label									
mitm	6.0	6754.0	3.553154	1.569620	1.0	2.0	5.0	5.0	8.0
mitm_36plc	6.0	188383.0	3.545108	1.558325	2.0	2.0	5.0	5.0	8.0
normal	6.0	164457.0	3.541515	1.553819	2.0	2.0	5.0	5.0	8.0

	TotLen Fwd Pkts								
	count	mean	std	min	25%	50%	75%	max	
Label									
mitm	6754.0	47.787385	48.099579	0.0	0.0	72.0	98.0	168.0	
mitm_36plc	188383.0	47.905904	48.129617	0.0	0.0	72.0	96.0	100.0	
normal	164457.0	47.981515	48.193465	0.0	0.0	72.0	96.0	100.0	

	TotLen Bwd Pkts								
	count	mean	std	min	25%	50%	75%	max	
Label									
mitm	6754.0	38.269174	38.660947	0.0	0.0	72.0	72.0	100.0	
mitm_36plc	188383.0	38.543924	38.853495	0.0	0.0	72.0	78.0	100.0	
normal	164457.0	38.461665	38.756286	0.0	0.0	72.0	78.0	100.0	

	Fwd Pkt Len Max							
	count	mean	std	min	25%	50%	75%	max
Label								

mitm	6754.0	33.752147	34.166059	0.0	0.0	44.0	70.0	72.0
mitm_36plc	188383.0	33.901817	34.226893	0.0	0.0	44.0	68.0	72.0
normal	164457.0	33.978535	34.284204	0.0	0.0	44.0	68.0	72.0

Fwd Pkt Len Min \								
Label	count	mean	std	min	25%	50%	75%	max
mitm	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mitm_36plc	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Fwd Pkt Len Mean \									
Label	count	mean	std	min	25%	50%	75%	max	
mitm	6754.0	9.749585	9.755739	0.0	0.0	18.0	19.6	28.0	
mitm_36plc	188383.0	9.746797	9.750116	0.0	0.0	18.0	19.2	25.0	
normal	164457.0	9.749339	9.753269	0.0	0.0	18.0	19.2	20.0	

Fwd Pkt Len Std \							
Label	count	mean	std	min	25%	50%	
mitm	6754.0	14.920295	15.028194	0.0	0.0	21.786846	
mitm_36plc	188383.0	14.965210	15.048824	0.0	0.0	21.786846	
normal	164457.0	14.990621	15.069873	0.0	0.0	21.786846	

Bwd Pkt Len Max \						
Label	75%	max	count	mean	std	min
mitm	30.672463	34.292856	6754.0	24.265028	24.886134	0.0
mitm_36plc	29.852973	34.000000	188383.0	24.539836	25.033469	0.0
normal	29.852973	31.496031	164457.0	24.458685	24.926832	0.0

Bwd Pkt Len Min \										
Label	25%	50%	75%	max	count	mean	std	min	25%	50%
mitm	0.0	44.0	44.0	72.0	6754.0	0.0	0.0	0.0	0.0	0.0
mitm_36plc	0.0	44.0	50.0	72.0	188383.0	0.0	0.0	0.0	0.0	0.0
normal	0.0	44.0	50.0	72.0	164457.0	0.0	0.0	0.0	0.0	0.0

Bwd Pkt Len Mean \									
Label	75%	max	count	mean	std	min	25%	50%	
mitm	0.0	0.0	6754.0	7.480942	7.496550	0.0	0.0	12.375	
mitm_36plc	0.0	0.0	188383.0	7.563971	7.577124	0.0	0.0	12.000	
normal	0.0	0.0	164457.0	7.558702	7.572162	0.0	0.0	12.000	

Bwd Pkt Len Std \			
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	75%	max	count	mean	std	min	25%
Label							
mitm	14.4	16.666667	6754.0	11.012655	11.146532	0.0	0.0
mitm_36plc	15.6	16.666667	188383.0	11.127344	11.233186	0.0	0.0
normal	15.6	16.666667	164457.0	11.102558	11.203735	0.0	0.0

	Flow Byts/s				
	50%	75%	max	count	mean
Label					
mitm	20.51341	20.513410	29.330303	6754.0	106.448680
mitm_36plc	20.51341	22.733236	29.330303	188383.0	1094.954881
normal	20.51341	22.733236	29.330303	164457.0	1164.924351

	std	min	25%	50%	75%	max
Label						
mitm	107.724388	0.0	0.0	1.992790	216.632122	338.550777
mitm_36plc	1109.816059	0.0	0.0	2.007809	2210.650760	2991.746905
normal	1180.243370	0.0	0.0	1.803155	2355.486778	3057.083121

	Flow Pkts/s				
	count	mean	std	min	25%
Label					
mitm	6754.0	35418.533351	39916.649455	0.121104	12.613931
mitm_36plc	188383.0	90833.995794	99095.427321	0.100000	127.946774
normal	164457.0	71186.095216	78249.038332	0.102118	136.278772

	Flow IAT Mean				
	50%	75%	max	count	
Label					
mitm	16.231172	57142.857143	142857.142857	6754.0	
mitm_36plc	165.130949	181818.181818	400000.000000	188383.0	
normal	172.962502	142857.142857	285714.285714	164457.0	

	mean	std	min	25%	50%
Label					
mitm	47810.307408	144692.168035	14.0	35.0	69502.500000
mitm_36plc	6776.849563	139659.181256	5.0	11.0	6728.666667
normal	6053.155641	129522.082678	7.0	14.0	6424.000000

	Flow IAT Std				
	75%	max	count	mean	
Label					
mitm	88088.583333	9.008016e+06	6754.0	61929.003762	
mitm_36plc	8684.166667	1.090909e+07	188383.0	15207.344502	
normal	8153.222222	1.068283e+07	164457.0	13498.581455	

	std	min	25%	50%	75%	\
Label						
mitm	455455.016393	0.0	0.0	75823.085052	105804.078147	
mitm_36plc	462689.885739	0.0	0.0	11859.989497	14094.021412	
normal	429158.498273	0.0	0.0	11627.964869	13719.697409	

	Flow IAT Max					\
	max	count	mean	std	min	
Label						
mitm	2.963342e+07	6754.0	165512.691146	1.508231e+06	14.0	
mitm_36plc	3.615716e+07	188383.0	49186.555385	1.534704e+06	5.0	
normal	3.540754e+07	164457.0	43585.339639	1.423458e+06	7.0	

	Flow IAT Min						\
	25%	50%	75%	max	count	mean	
Label							
mitm	35.0	194066.0	276949.75	98355743.0	6754.0	63.708617	
mitm_36plc	11.0	37497.0	44321.00	119927029.0	188383.0	12.346714	
normal	14.0	36986.0	43238.00	117440559.0	164457.0	16.784807	

	Fwd IAT Tot							\
	std	min	25%	50%	75%	max	count	
Label								
mitm	1664.419176	13.0	20.0	29.0	38.0	100501.0	6754.0	
mitm_36plc	5.497144	4.0	8.0	11.0	16.0	406.0	188383.0	
normal	9.151835	4.0	11.0	14.0	22.0	2064.0	164457.0	

	mean	std	min	25%	50%	75%	\
Label							
mitm	314562.587060	315999.420297	0.0	0.0	470988.5	628555.0	
mitm_36plc	34614.072215	35220.837825	0.0	0.0	51083.0	67361.0	
normal	34062.665639	34647.273340	0.0	0.0	50543.0	66317.0	

	Fwd IAT Mean						\
	max	count	mean	std	min	25%	
Label							
mitm	776518.0	6754.0	81354.608528	82457.804395	0.0	0.0	
mitm_36plc	229220.0	188383.0	8885.135330	9062.045093	0.0	0.0	
normal	156975.0	164457.0	8727.146386	8898.843536	0.0	0.0	

	Fwd IAT Std					\
	50%	75%	max	count	mean	
Label						
mitm	118766.25	158968.375	252569.00	6754.0	74244.508187	

mitm_36plc	13306.00	17228.750	57305.00	188383.0	10548.331855
normal	13176.00	16922.000	39243.75	164457.0	10256.294977

	std	min	25%	50%	75%
Label					
mitm	75455.695403	0.0	0.0	65767.341155	151067.292561
mitm_36plc	10815.442744	0.0	0.0	15065.157716	19836.705001
normal	10501.460605	0.0	0.0	14713.764316	19285.950368

	Fwd IAT Max						
	max	count	mean	std	min	25%	
Label							
mitm	201558.904417	6754.0	154264.025318	155730.636886	0.0	0.0	
mitm_36plc	99892.936230	188383.0	23655.525148	24129.986474	0.0	0.0	
normal	68549.944913	164457.0	23079.325629	23513.684397	0.0	0.0	

	Fwd IAT Min					
	50%	75%	max	count	mean	
Label						
mitm	204687.0	307223.25	438777.0	6754.0	6640.931744	
mitm_36plc	37500.0	44366.00	206711.0	188383.0	1217.281368	
normal	37016.0	43284.00	141872.0	164457.0	1221.682902	

	Bwd IAT Tot					
	std	min	25%	50%	75%	max
Label						count
mitm	18928.241434	0.0	0.0	1958.0	6095.25	135708.0
mitm_36plc	1417.517579	0.0	0.0	1204.0	2085.00	16531.0
normal	1431.210742	0.0	0.0	1239.0	2082.00	19406.0

	mean	std	min	25%	50%	75%
Label						
mitm	431217.406574	1.565578e+06	0.0	35.0	609929.0	785992.25
mitm_36plc	62640.287871	1.536110e+06	5.0	11.0	56631.0	72129.00
normal	55162.797917	1.424580e+06	7.0	14.0	54144.0	67067.00

	Bwd IAT Mean						
	max	count	mean	std	min	25%	
Label							
mitm	99088176.0	6754.0	102895.405747	237557.336597	0.0	35.0	
mitm_36plc	119999986.0	188383.0	12749.303370	219509.307229	5.0	11.0	
normal	117511126.0	164457.0	11443.127877	203580.924270	7.0	14.0	

	Bwd IAT Std			
	50%	75%	max	count
Label				mean

Label						
mitm	126171.9	194004.9125	1.415545e+07	6754.0	60112.545143	
mitm_36plc	12548.0	17757.5000	1.714286e+07	188383.0	19601.336573	
normal	11946.6	16542.2500	1.678730e+07	164457.0	17682.778109	

		std	min	25%	50%	75%	max
Label							
mitm	569092.745766	0.0	0.0	57030.169689	98073.563059	3.712901e+07	
mitm_36plc	579979.910079	0.0	0.0	14100.013163	18751.943017	4.532356e+07	
normal	537956.338481	0.0	0.0	14333.896201	18761.503636	4.438392e+07	

		Bwd IAT Max					
		count	mean	std	min	25%	50%
Label							
mitm	6754.0	173616.759994	1.508831e+06	0.0	35.0	213070.0	
mitm_36plc	188383.0	49405.281543	1.534704e+06	5.0	11.0	37921.0	
normal	164457.0	43794.498726	1.423459e+06	7.0	14.0	37471.0	

			Bwd IAT Min				
	75%	max	count	mean	std		
Label							
mitm	293905.25	98355743.0	6754.0	38636.816849	43667.114064		
mitm_36plc	44752.50	119927029.0	188383.0	1750.352845	2193.890666		
normal	43664.00	117440559.0	164457.0	1716.652025	2087.730052		

						Fwd PSH Flags			
	min	25%	50%	75%	max	count	mean	std	min
Label									
mitm	0.0	35.0	105.5	81205.25	151454.0	6754.0	0.0	0.0	0.0
mitm_36plc	5.0	11.0	65.0	2841.00	14882.0	188383.0	0.0	0.0	0.0
normal	7.0	14.0	103.0	3182.00	13849.0	164457.0	0.0	0.0	0.0

						Bwd PSH Flags				
	25%	50%	75%	max		count	mean	std	min	25%
Label										
mitm	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0	0.0	0.0
mitm_36plc	0.0	0.0	0.0	0.0	188383.0	0.0	0.0	0.0	0.0	0.0
normal	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0	0.0	0.0

						Fwd URG Flags				
	max		count	mean	std	min	25%	50%	75%	max
Label										
mitm	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mitm_36plc	0.0	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Bwd URG Flags								Fwd Header Len \	
Label	count	mean	std	min	25%	50%	75%	max	count	
mitm	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	
mitm_36plc	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188383.0	
normal	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	

Label	mean	std	min	25%	50%	75%	max
mitm	78.790643	78.922803	0.0	0.0	136.0	160.0	192.0
mitm_36plc	78.965214	79.089035	0.0	0.0	136.0	160.0	192.0
normal	79.039846	79.159871	0.0	0.0	136.0	160.0	192.0

	Bwd Header Len							
Label	count	mean	std	min	25%	50%	75%	
mitm	6754.0	121.288126	57.548323	44.0	64.0	176.0	176.0	
mitm_36plc	188383.0	121.093007	57.296271	64.0	64.0	176.0	176.0	
normal	164457.0	121.004080	57.193933	64.0	64.0	176.0	176.0	

	Fwd Pkts/s						
Label	max	count	mean	std	min	25%	50%
mitm	264.0	6754.0	3.035348	3.084742	0.0	0.0	3.770851
mitm_36plc	264.0	188383.0	31.116261	31.636463	0.0	0.0	0.046454
normal	264.0	164457.0	33.152261	33.689838	0.0	0.0	0.041677

	Bwd Pkts/s					
Label	75%	max	count	mean	std	
mitm	6.213025	15.614265	6754.0	35415.498003	39919.342230	
mitm_36plc	62.969913	87.624500	188383.0	90802.879533	99123.910254	
normal	67.281168	96.677516	164457.0	71152.942954	78279.141975	

	min	25%	50%	75%	max
Label					
mitm	0.080736	6.368036	9.511096	57142.857143	142857.142857
mitm_36plc	0.066667	64.648763	95.632770	181818.181818	400000.000000
normal	0.068079	68.809865	100.446989	142857.142857	285714.285714

	Pkt Len Min								Pkt Len Max \
Label	count	mean	std	min	25%	50%	75%	max	count
mitm	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0
mitm_36plc	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188383.0

normal	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0
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								Pkt Len Mean \
	mean	std	min	25%	50%	75%	max	count
Label								
mitm	35.010364	35.021639	0.0	0.0	68.0	70.0	72.0	6754.0
mitm_36plc	34.898733	34.916479	0.0	0.0	66.0	68.0	72.0	188383.0
normal	34.897913	34.918514	0.0	0.0	66.0	68.0	72.0	164457.0

	mean	std	min	25%	50%	75%	max	
Label								
mitm	7.821808	7.821432	0.0	0.0	13.153846	15.636364	20.000000	
mitm_36plc	7.858376	7.856614	0.0	0.0	13.384615	15.636364	17.200000	
normal	7.857901	7.856737	0.0	0.0	13.384615	15.636364	15.818182	

	Pkt Len Std							
	count	mean	std	min	25%	50%	75%	
Label								
mitm	6754.0	12.154557	12.152875	0.0	0.0	22.905756	24.371369	
mitm_36plc	188383.0	12.198329	12.195228	0.0	0.0	23.027297	24.371369	
normal	164457.0	12.197651	12.195516	0.0	0.0	23.027297	24.371369	

	Pkt Len Var						
	max	count	mean	std	min	25%	
Label							
mitm	27.804512	6754.0	295.403750	295.439760	0.0	0.0	
mitm_36plc	25.231374	188383.0	297.522027	297.476984	0.0	0.0	
normal	24.491928	164457.0	297.512394	297.490619	0.0	0.0	

				FIN Flag Cnt		
	50%	75%	max	count	mean	
Label						
mitm	524.717949	593.963636	773.090909	6754.0	0.499704	
mitm_36plc	530.256410	593.963636	636.622222	188383.0	0.500141	
normal	530.256410	593.963636	599.854545	164457.0	0.500106	

							SYN Flag Cnt	
	std	min	25%	50%	75%	max	count	mean
Label								
mitm	0.500037	0.0	0.0	0.0	1.0	1.0	6754.0	0.499852
mitm_36plc	0.500001	0.0	0.0	1.0	1.0	1.0	188383.0	0.499859
normal	0.500002	0.0	0.0	1.0	1.0	1.0	164457.0	0.499894

								RST Flag Cnt	
	std	min	25%	50%	75%	max	count	mean	std min
Label									

mitm	0.500037	0.0	0.0	0.0	1.0	1.0	6754.0	0.0	0.0	0.0
mitm_36plc	0.500001	0.0	0.0	0.0	1.0	1.0	188383.0	0.0	0.0	0.0
normal	0.500002	0.0	0.0	0.0	1.0	1.0	164457.0	0.0	0.0	0.0

PSH Flag Cnt \											
	25%	50%	75%	max	count	mean	std	min	25%	50%	75%
Label											
mitm	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0
mitm_36plc	0.0	0.0	0.0	0.0	188383.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0

ACK Flag Cnt \											
	max	count	mean	std	min	25%	50%	75%	max		
Label											
mitm	0.0	6754.0	0.500148	0.500037	0.0	0.0	1.0	1.0	1.0		
mitm_36plc	0.0	188383.0	0.500141	0.500001	0.0	0.0	1.0	1.0	1.0		
normal	0.0	164457.0	0.500106	0.500002	0.0	0.0	1.0	1.0	1.0		

URG Flag Cnt \											
	count	mean	std	min	25%	50%	75%	max	CWE Flag Count	count	
Label											
mitm	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0		
mitm_36plc	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188383.0		
normal	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0		

ECE Flag Cnt \											
	mean	std	min	25%	50%	75%	max	count	mean	std	min
Label											
mitm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0
mitm_36plc	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188383.0	0.0	0.0	0.0
normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0

Down/Up Ratio \											
	25%	50%	75%	max	count	mean	std	min	25%		
Label											
mitm	0.0	0.0	0.0	0.0	6754.0	0.500444	0.500629	0.0	0.0		
mitm_36plc	0.0	0.0	0.0	0.0	188383.0	0.500422	0.500574	0.0	0.0		
normal	0.0	0.0	0.0	0.0	164457.0	0.500283	0.500427	0.0	0.0		

Pkt Size Avg \											
	50%	75%	max	count	mean	std	min	25%	50%		
Label											
mitm	1.0	1.0	2.0	6754.0	8.603843	8.603407	0.0	0.0	14.25		
mitm_36plc	1.0	1.0	2.0	188383.0	8.644150	8.642232	0.0	0.0	14.50		
normal	1.0	1.0	2.0	164457.0	8.643638	8.642374	0.0	0.0	14.50		

Fwd Seg Size Avg \											
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	75%	max	count	mean	std	min	25%
Label							
mitm	17.2	21.818182	6754.0	9.749585	9.755739	0.0	0.0
mitm_36plc	17.2	19.111111	188383.0	9.746797	9.750116	0.0	0.0
normal	17.2	17.400000	164457.0	9.749339	9.753269	0.0	0.0

	Bwd Seg Size Avg \							
	50%	75%	max	count	mean	std	min	25%
Label								
mitm	18.0	19.6	28.0	6754.0	7.480942	7.496550	0.0	0.0
mitm_36plc	18.0	19.2	25.0	188383.0	7.563971	7.577124	0.0	0.0
normal	18.0	19.2	20.0	164457.0	7.558702	7.572162	0.0	0.0

	Fwd Byts/b Avg \								
	50%	75%	max	count	mean	std	min	25%	50%
Label									
mitm	12.375	14.4	16.666667	6754.0	0.0	0.0	0.0	0.0	0.0
mitm_36plc	12.000	15.6	16.666667	188383.0	0.0	0.0	0.0	0.0	0.0
normal	12.000	15.6	16.666667	164457.0	0.0	0.0	0.0	0.0	0.0

	Fwd Pkts/b Avg \									
	75%	max	count	mean	std	min	25%	50%	75%	max
Label										
mitm	0.0	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mitm_36plc	0.0	0.0	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	0.0	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Fwd Blk Rate Avg \									
	count	mean	std	min	25%	50%	75%	max	Bwd Byts/b Avg	count
Label										
mitm	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	
mitm_36plc	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188383.0	
normal	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	

	Bwd Pkts/b Avg							\			
	mean	std	min	25%	50%	75%	max	count	mean	std	min
Label											
mitm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0
mitm_36plc	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188383.0	0.0	0.0	0.0
normal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0

	Bwd Blk Rate Avg \											
	25%	50%	75%	max	count	mean	std	min	25%	50%	75%	
Label												
mitm	0.0	0.0	0.0	0.0	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	
mitm_36plc	0.0	0.0	0.0	0.0	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	
normal	0.0	0.0	0.0	0.0	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	

	Subflow Fwd Pkts \								
	max	count	mean	std	min	25%	50%	75%	max
Label									
mitm	0.0	6754.0	2.449067	2.457426	0.0	0.0	4.0	5.0	6.0
mitm_36plc	0.0	188383.0	2.456639	2.464104	0.0	0.0	4.0	5.0	6.0
normal	0.0	164457.0	2.459804	2.466897	0.0	0.0	4.0	5.0	6.0

	Subflow Fwd Byts \							
	count	mean	std	min	25%	50%	75%	
Label								
mitm	6754.0	47.787385	48.099579	0.0	0.0	72.0	98.0	
mitm_36plc	188383.0	47.905904	48.129617	0.0	0.0	72.0	96.0	
normal	164457.0	47.981515	48.193465	0.0	0.0	72.0	96.0	

	Subflow Bwd Pkts \								
	max	count	mean	std	min	25%	50%	75%	
Label									
mitm	168.0	6754.0	3.553154	1.569620	1.0	2.0	5.0	5.0	
mitm_36plc	100.0	188383.0	3.545108	1.558325	2.0	2.0	5.0	5.0	
normal	100.0	164457.0	3.541515	1.553819	2.0	2.0	5.0	5.0	

	Subflow Bwd Byts \								
	max	count	mean	std	min	25%	50%	75%	
Label									
mitm	8.0	6754.0	38.269174	38.660947	0.0	0.0	72.0	72.0	
mitm_36plc	8.0	188383.0	38.543924	38.853495	0.0	0.0	72.0	78.0	
normal	8.0	164457.0	38.461665	38.756286	0.0	0.0	72.0	78.0	

	Init Fwd Win Byts \									
	max	count	mean	std	min	25%	50%	75%	max	
Label										
mitm	100.0	6754.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	
mitm_36plc	100.0	188383.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	
normal	100.0	164457.0	-1.0	0.0	-1.0	-1.0	-1.0	-1.0	-1.0	

	Init Bwd Win Byts \							
	count	mean	std	min	25%	50%	75%	
Label								
mitm	6754.0	83.896062	0.994657	83.0	83.0	83.0	85.0	
mitm_36plc	188383.0	83.912099	0.996132	83.0	83.0	83.0	85.0	
normal	164457.0	83.918684	0.996691	83.0	83.0	83.0	85.0	

	Fwd Act Data Pkts \								
	max	count	mean	std	min	25%	50%	75%	
Label									
mitm	85.0	6754.0	1.000740	1.000740	0.0	0.0	2.0	2.0	

mitm_36plc	85.0	188383.0	1.000292	1.000003	0.0	0.0	2.0	2.0
normal	85.0	164457.0	1.000213	1.000003	0.0	0.0	2.0	2.0

	Fwd Seg	Size Min	\						
	max	count	mean	std	min	25%	50%	75%	max
Label									
mitm	3.0	6754	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mitm_36plc	2.0	188383	0.0	0.0	0.0	0.0	0.0	0.0	0.0
normal	2.0	164457	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Active Mean \							
Label	count	mean	std	min	25%	50%	75%	max
mitm	6754.0	0.008884	0.549823	0.0	0.0	0.0	0.0	41.0
mitm_36plc	188383.0	0.003668	0.236835	0.0	0.0	0.0	0.0	27.0
normal	164457.0	0.003867	0.287735	0.0	0.0	0.0	0.0	36.0

	Active Std							Active Max			\
Label	count	mean	std	min	25%	50%	75%	max	count	mean	
mitm	6754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6754.0	0.008884	
mitm_36plc	188383.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188383.0	0.003668	
normal	164457.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164457.0	0.003867	

Label	Active						Min		
	std	min	25%	50%	75%	max	count	mean	std
mitm	0.549823	0.0	0.0	0.0	0.0	41.0	6754.0	0.008884	0.549823
mitm_36plc	0.236835	0.0	0.0	0.0	0.0	27.0	188383.0	0.003668	0.236835
normal	0.287735	0.0	0.0	0.0	0.0	36.0	164457.0	0.003867	0.287735

	Idle					Mean		\	
	min	25%	50%	75%	max	count	mean	std	
Label									
mitm	0.0	0.0	0.0	0.0	41.0	6754.0	25647.077584	1.503937e+06	
mitm_36plc	0.0	0.0	0.0	0.0	27.0	188383.0	25559.405679	1.534908e+06	
normal	0.0	0.0	0.0	0.0	36.0	164457.0	20526.033231	1.423597e+06	

						Idle Std					\
	min	25%	50%	75%	max	count	mean	std	min	25%	
Label											
mitm	0.0	0.0	0.0	0.0	98355743.0	6754.0	0.0	0.0	0.0	0.0	
mitm_36plc	0.0	0.0	0.0	0.0	119927029.0	188383.0	0.0	0.0	0.0	0.0	
normal	0.0	0.0	0.0	0.0	117440559.0	164457.0	0.0	0.0	0.0	0.0	

	50%	75%	max	Idle	Max					
				count	mean	std	min	25%		\

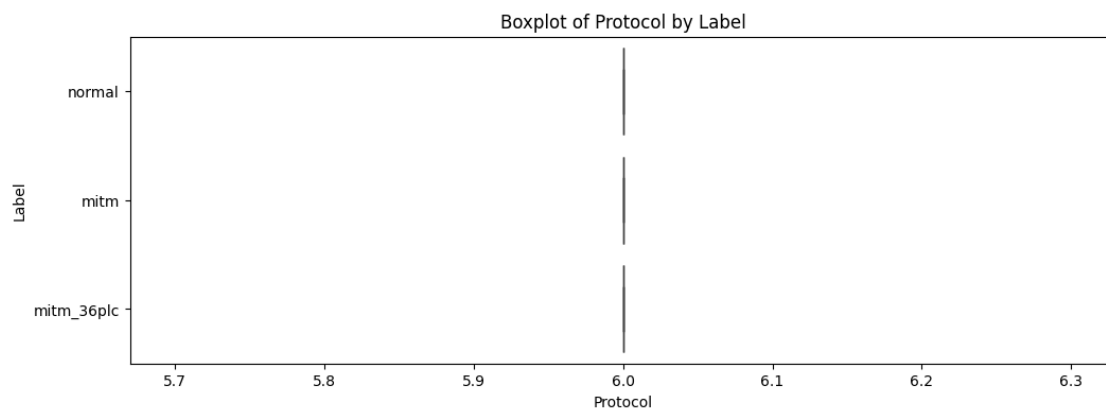
Label									
mitm	0.0	0.0	0.0	6754.0	25647.077584	1.503937e+06	0.0	0.0	
mitm_36plc	0.0	0.0	0.0	188383.0	25559.405679	1.534908e+06	0.0	0.0	
normal	0.0	0.0	0.0	164457.0	20526.033231	1.423597e+06	0.0	0.0	

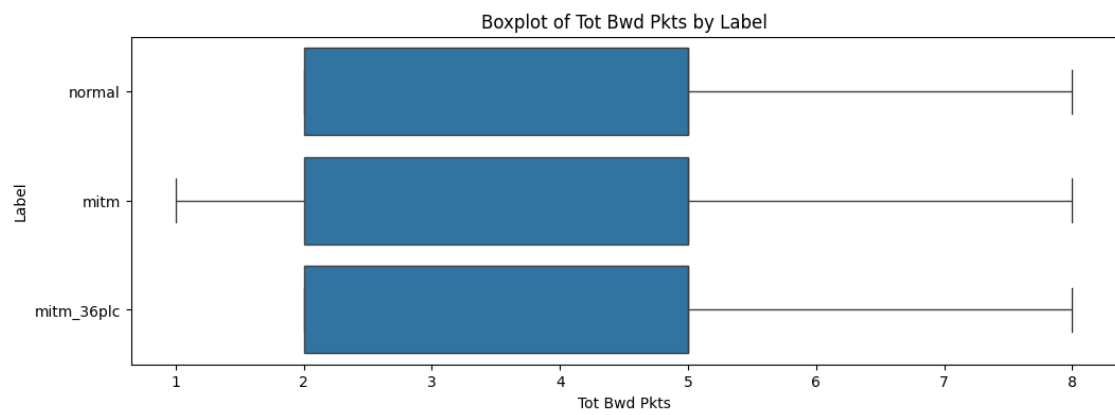
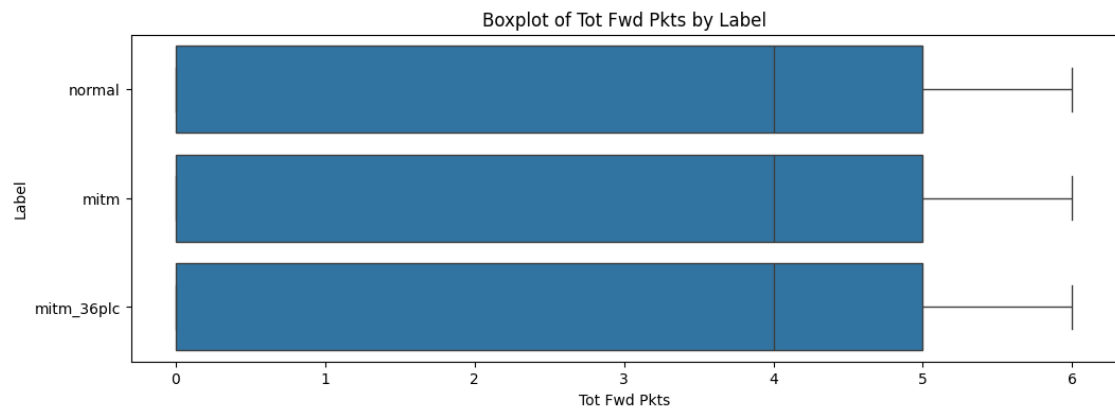
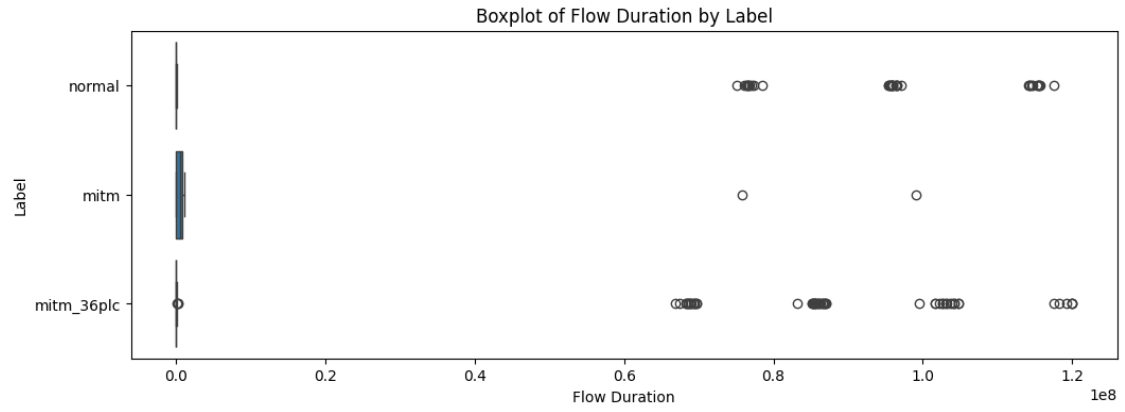
				Idle Min					\
Label	50%	75%		count		mean	std	min	
mitm	0.0	0.0	98355743.0	6754.0	25647.077584	1.503937e+06	0.0		
mitm_36plc	0.0	0.0	119927029.0	188383.0	25559.405679	1.534908e+06	0.0		
normal	0.0	0.0	117440559.0	164457.0	20526.033231	1.423597e+06	0.0		

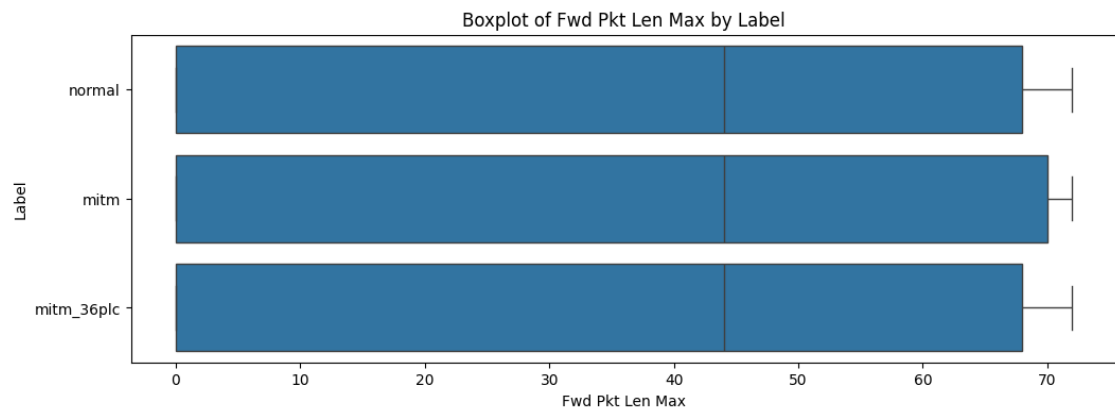
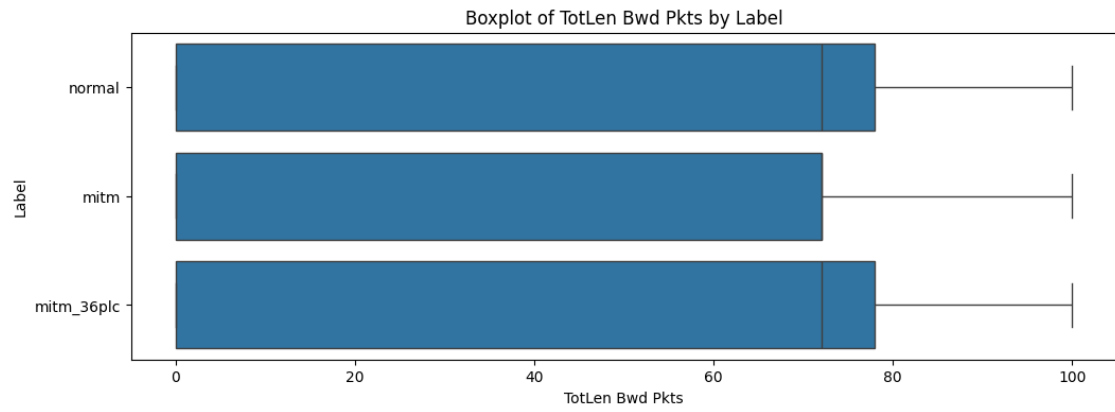
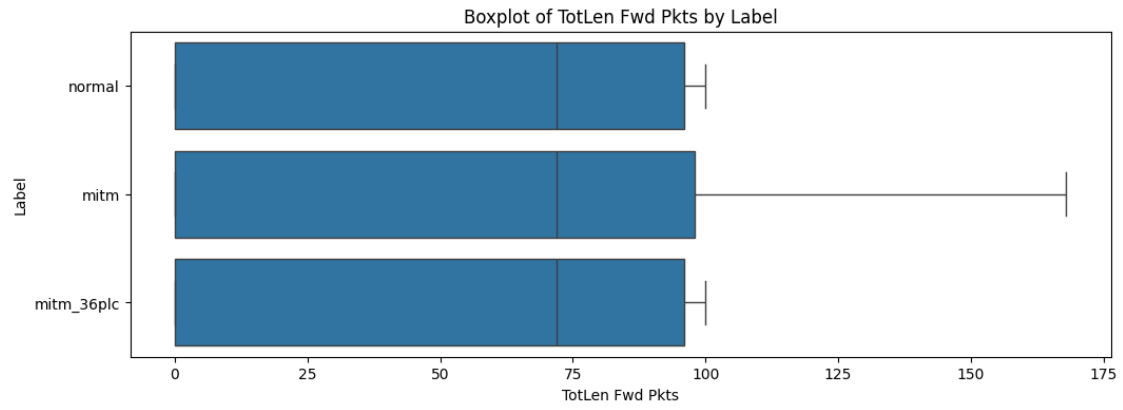
	25%	50%	75%	max
mitm	0.0	0.0	0.0	98355743.0
mitm_36plc	0.0	0.0	0.0	119927029.0
normal	0.0	0.0	0.0	117440559.0

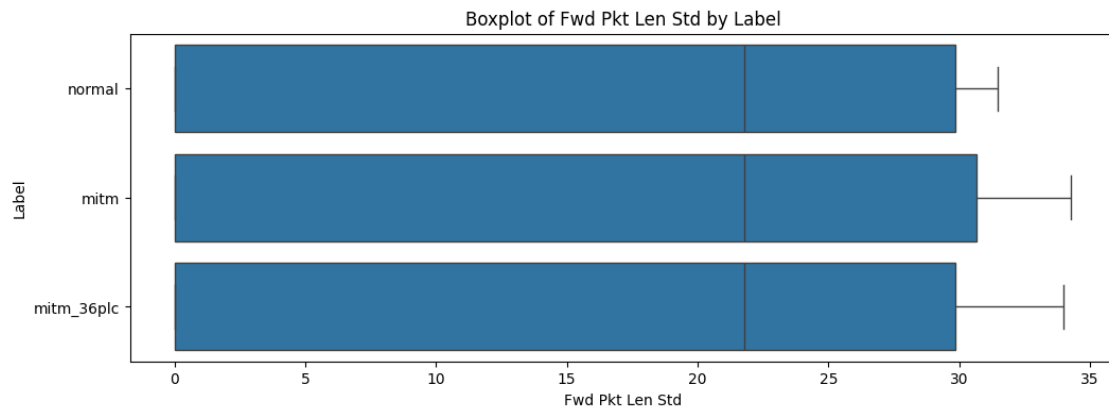
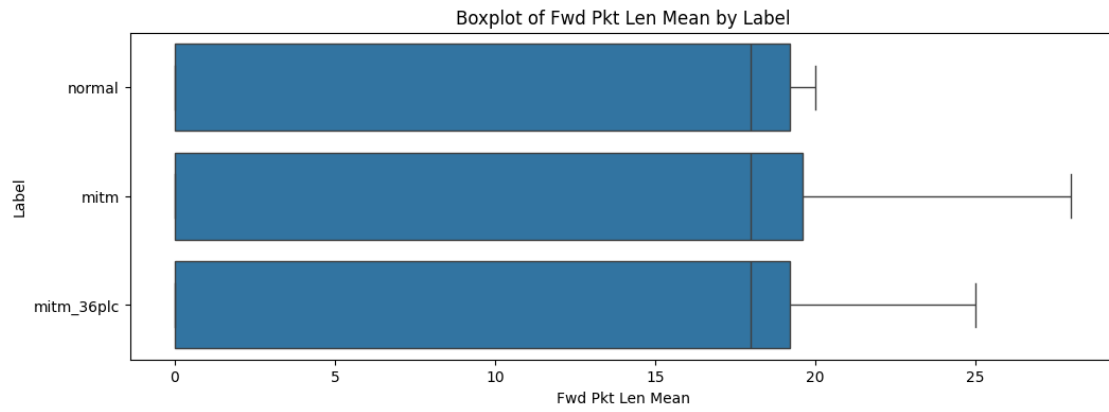
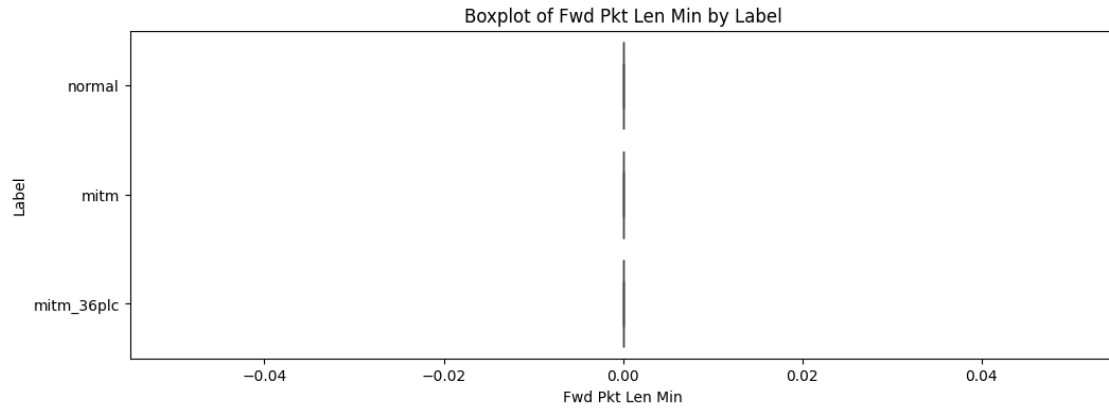
```
[25]: import seaborn as sns
import matplotlib.pyplot as plt

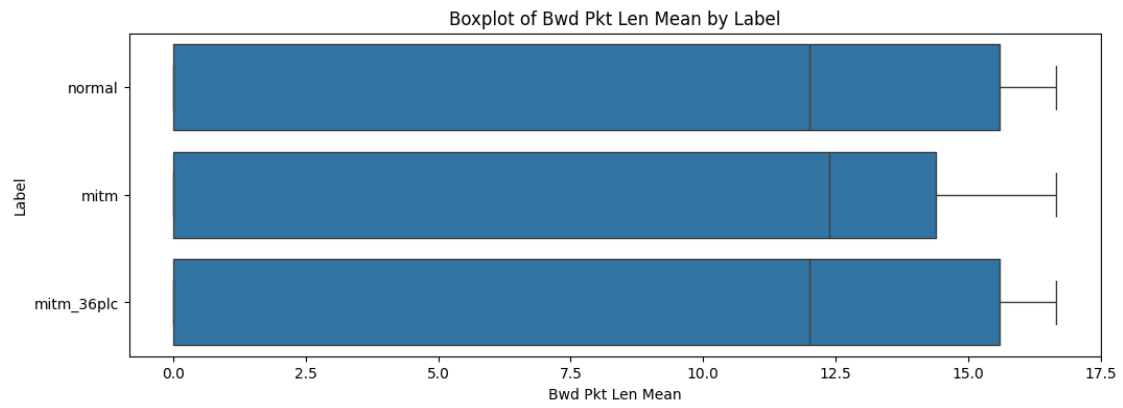
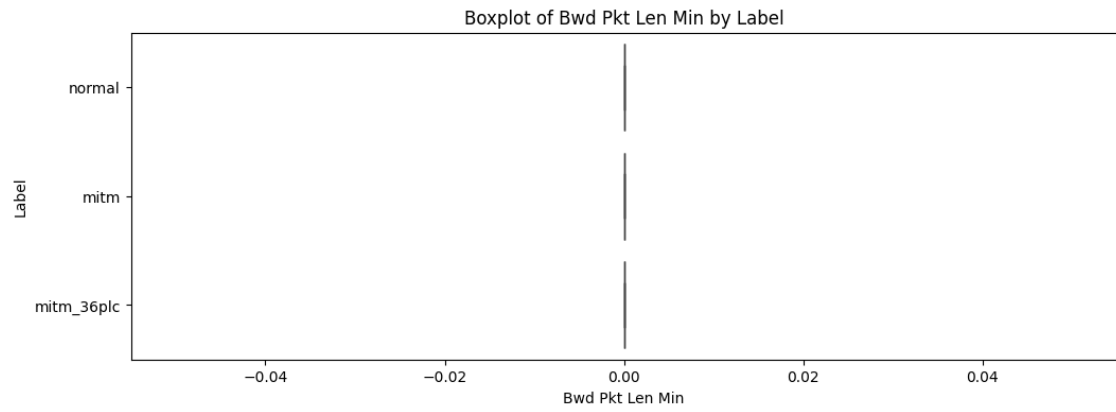
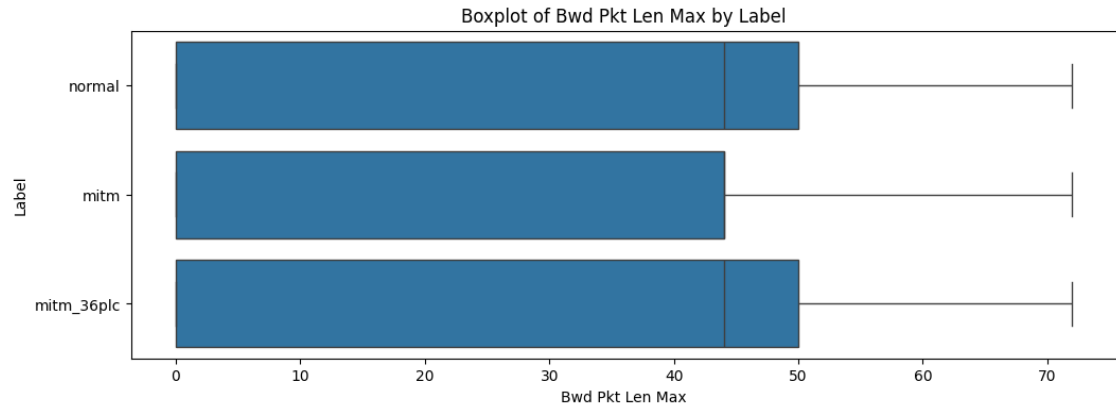
for col in df.select_dtypes(include='number').columns:
    plt.figure(figsize=(12, 4))
    sns.boxplot(y='Label', x=col, data=df)
    plt.title(f'Boxplot of {col} by Label')
    plt.show()
```

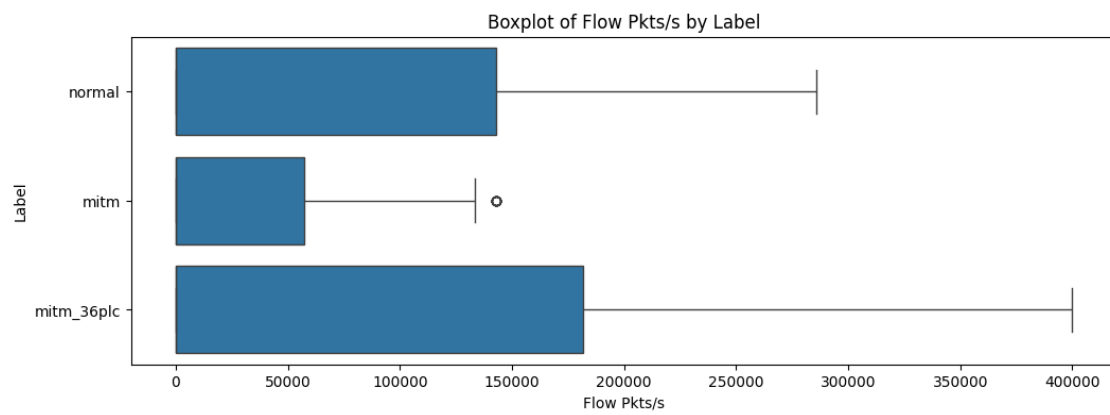
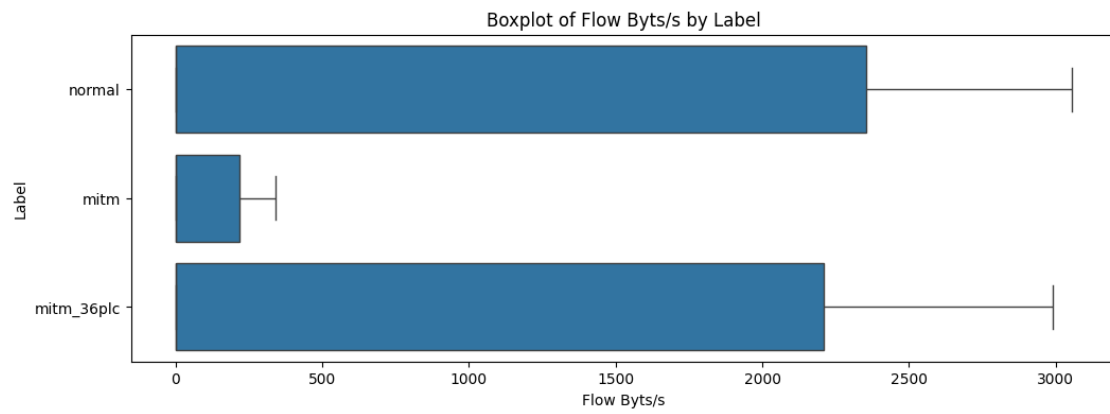
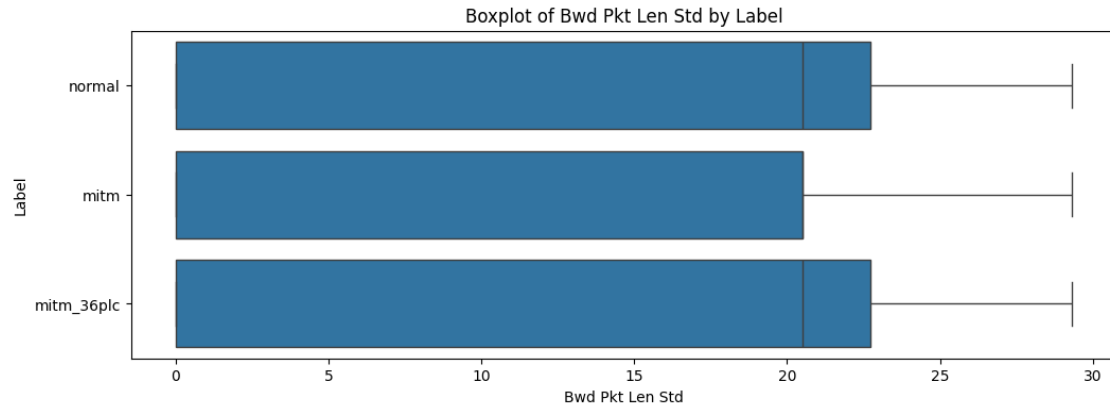


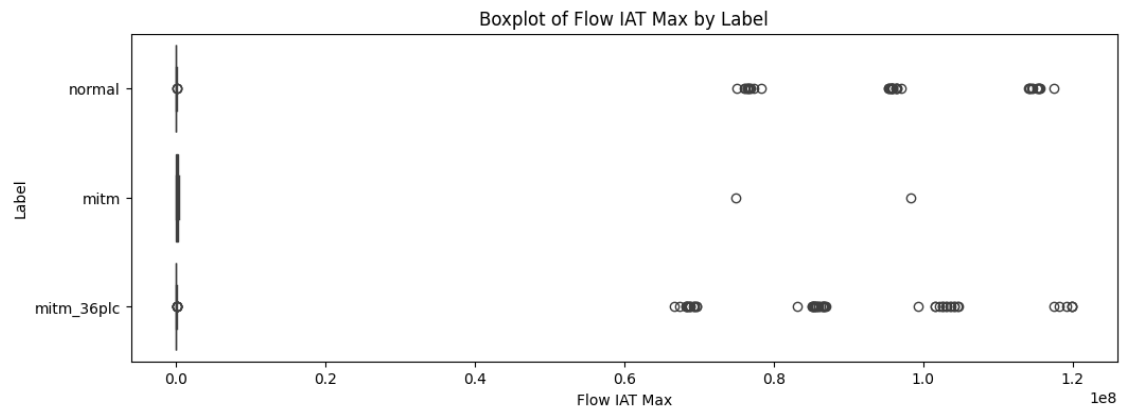
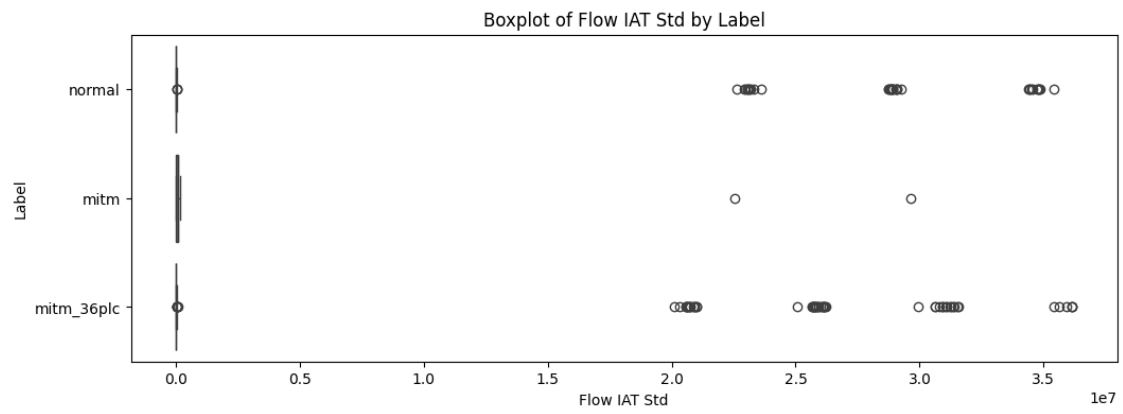
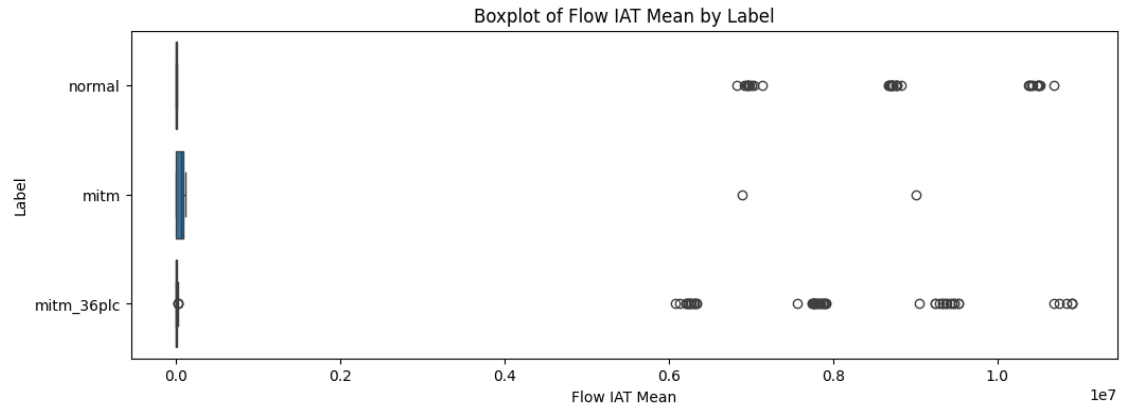


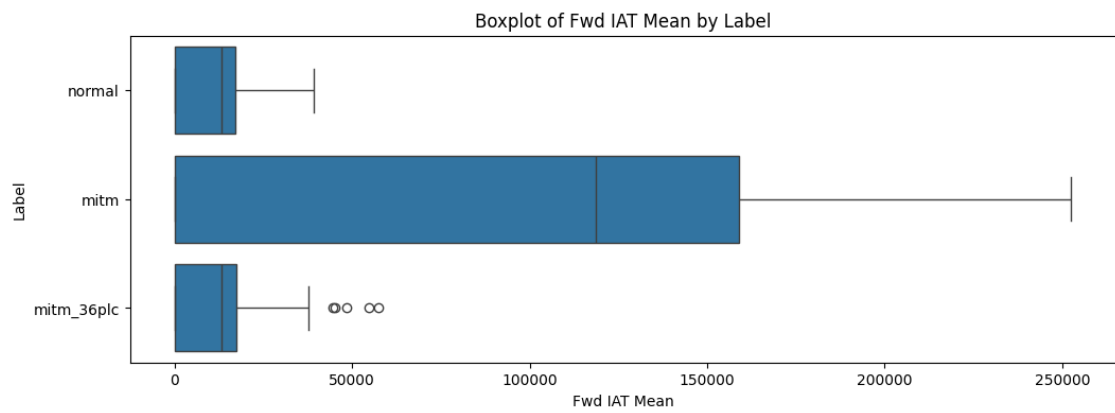
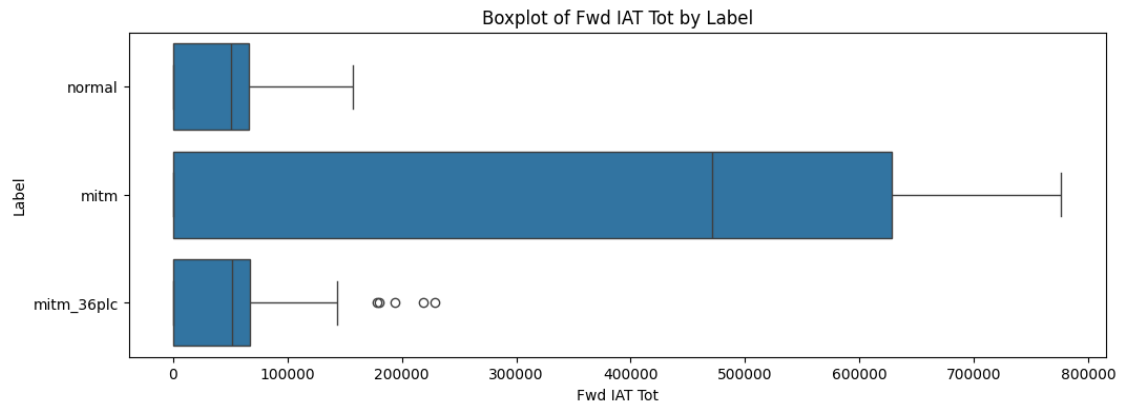
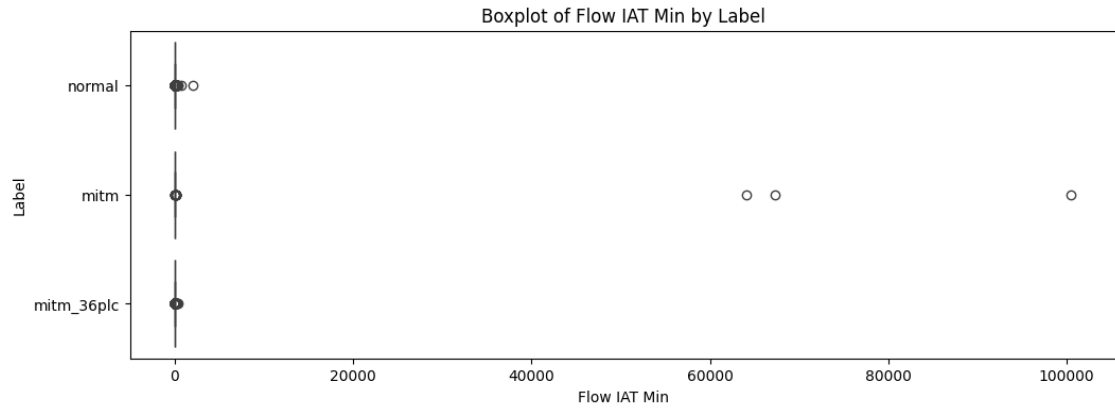


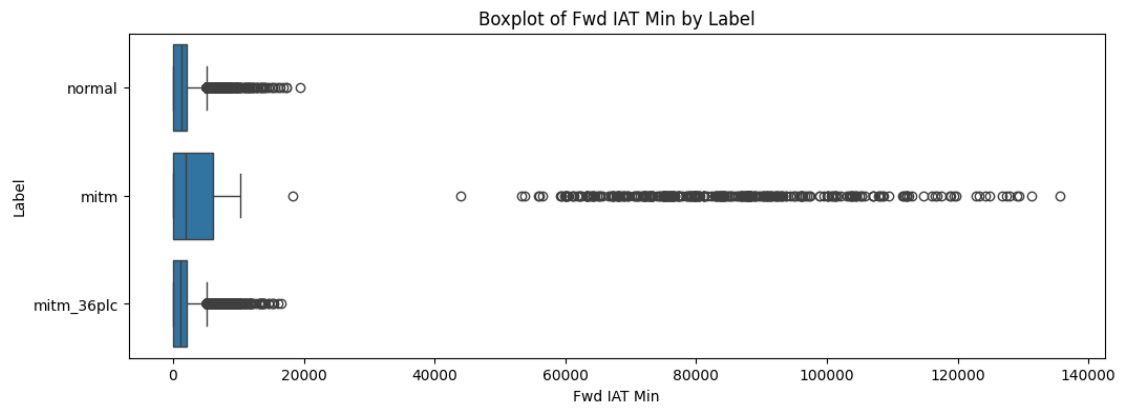
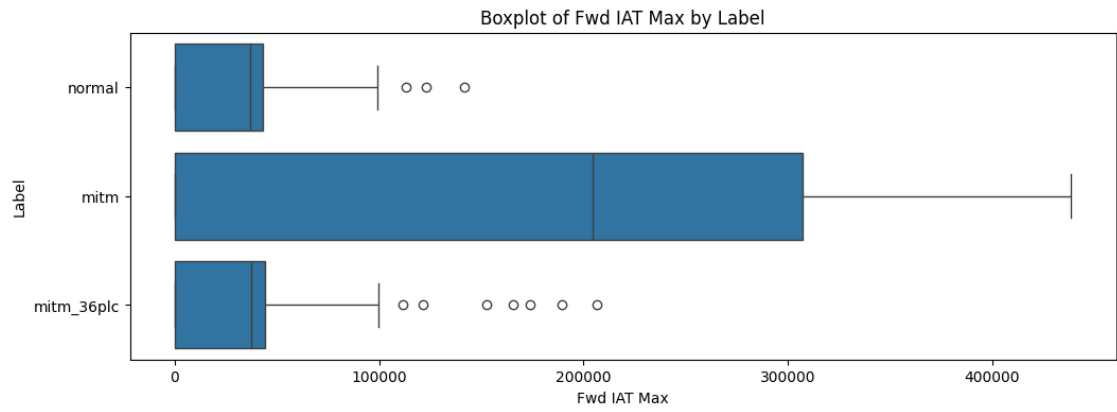
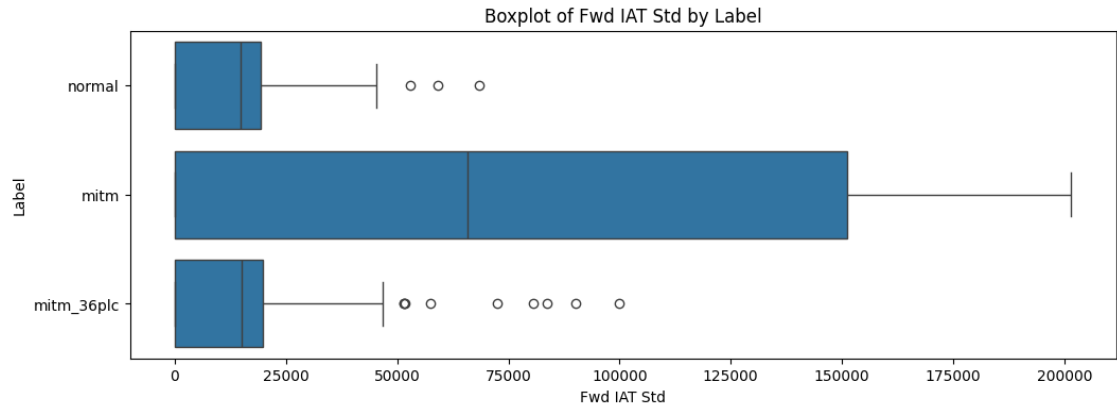


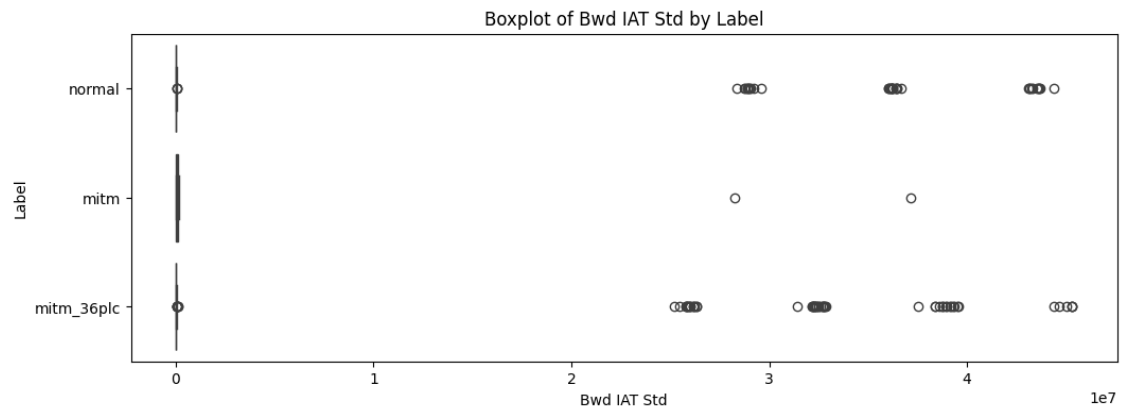
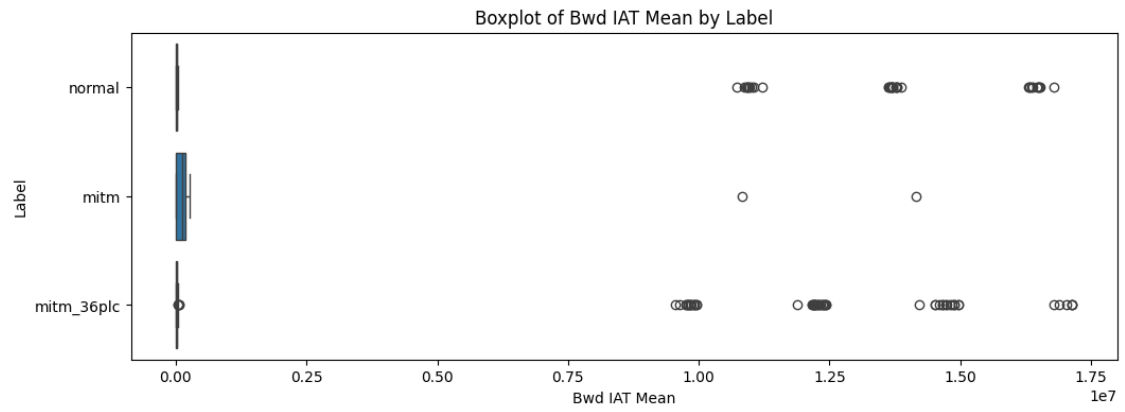
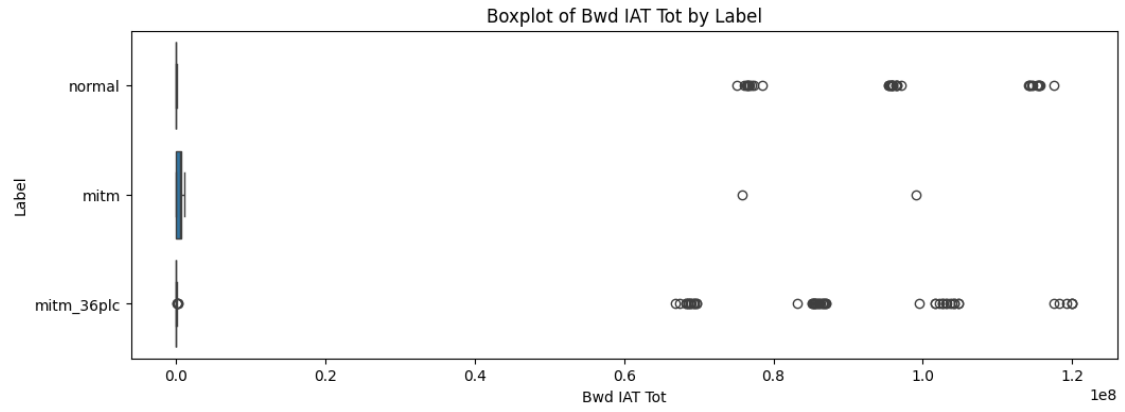


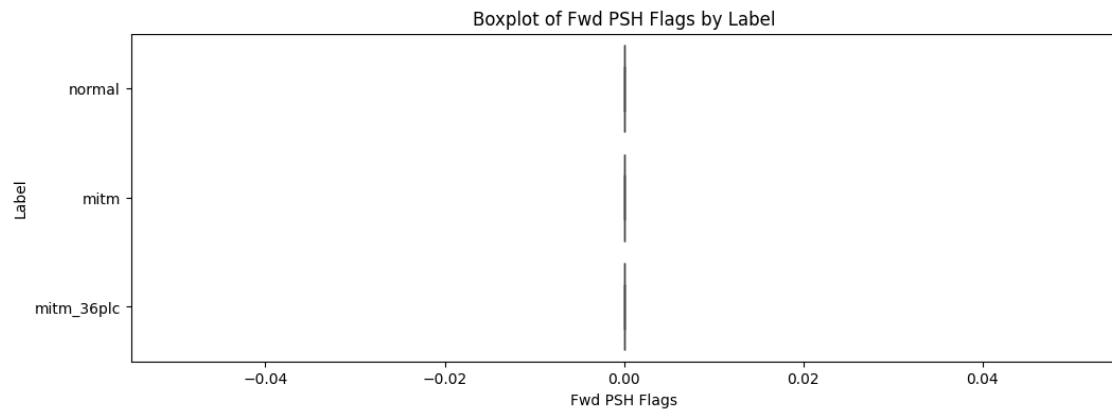
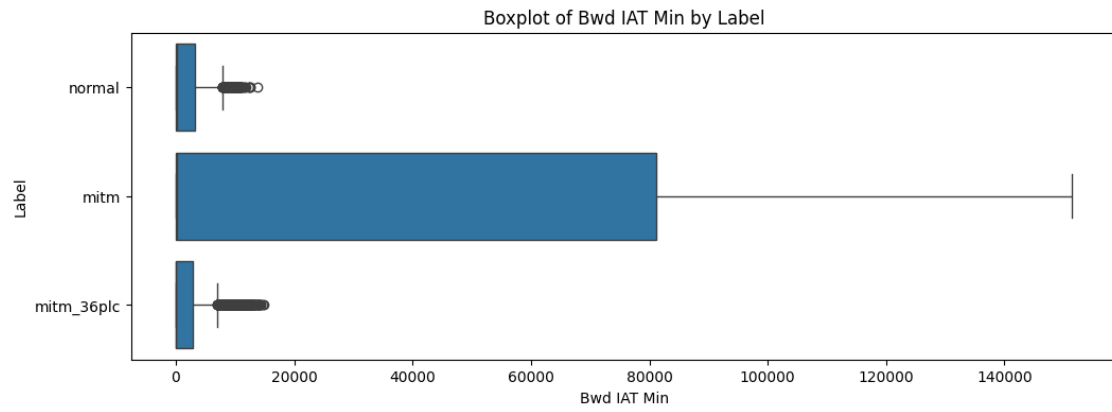
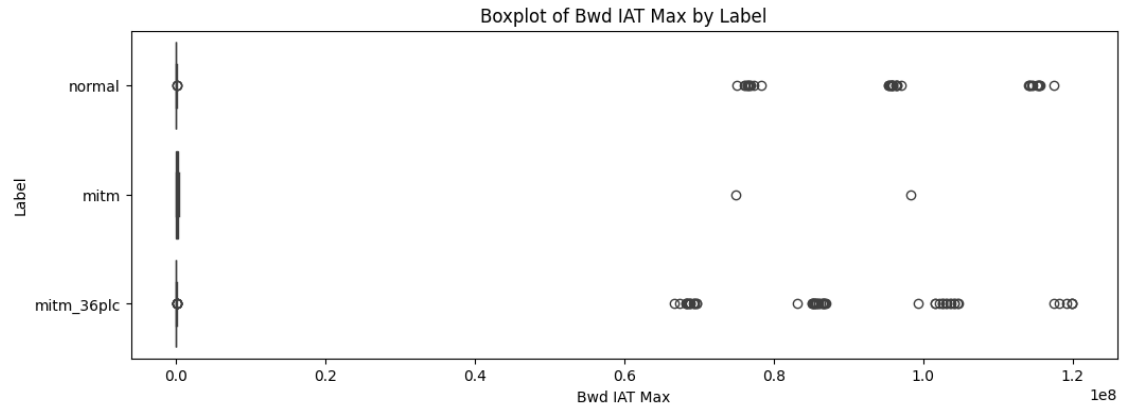


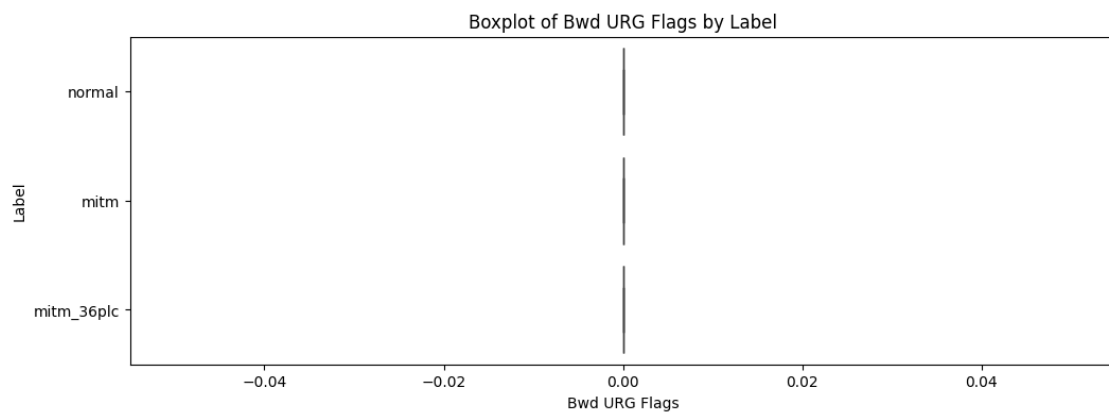
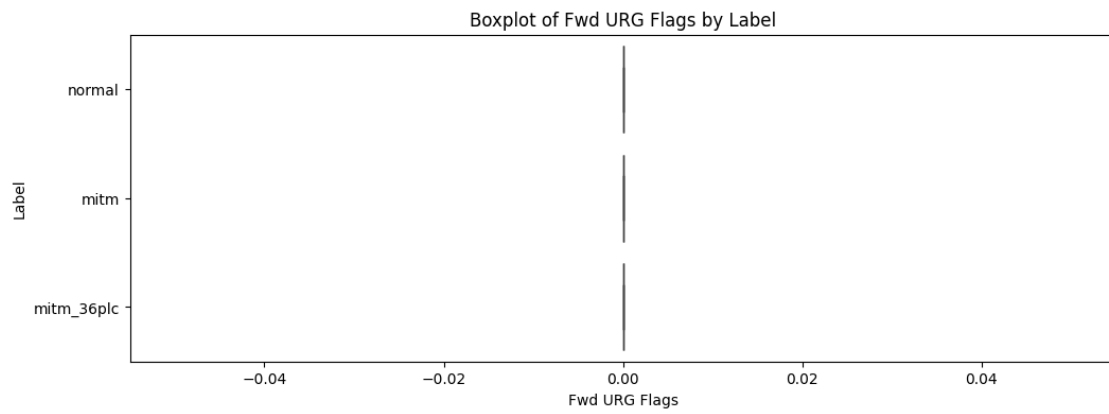
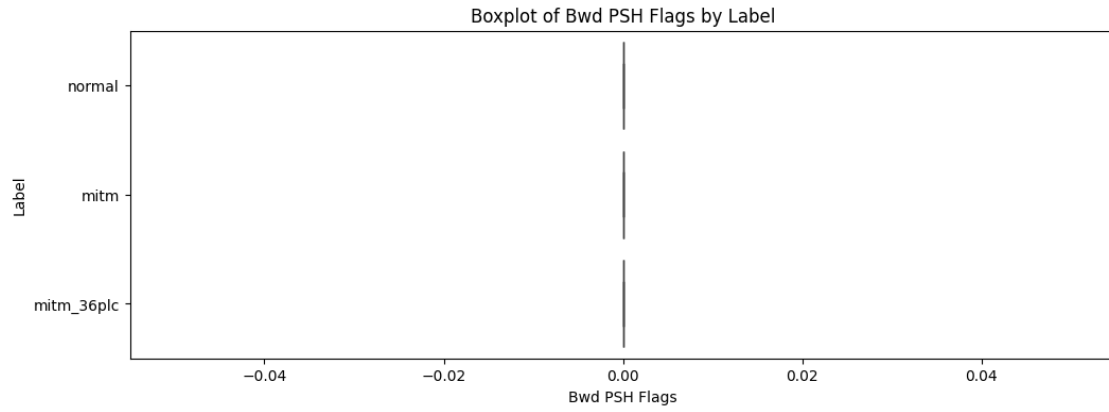


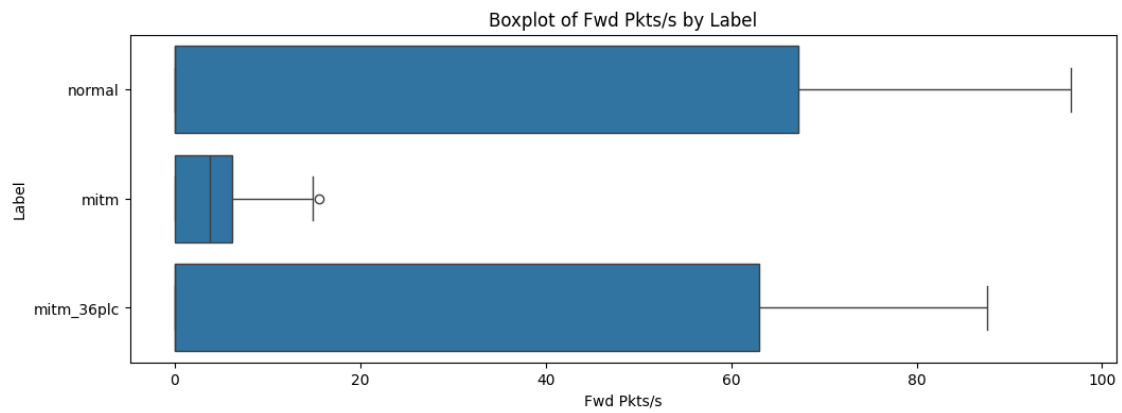
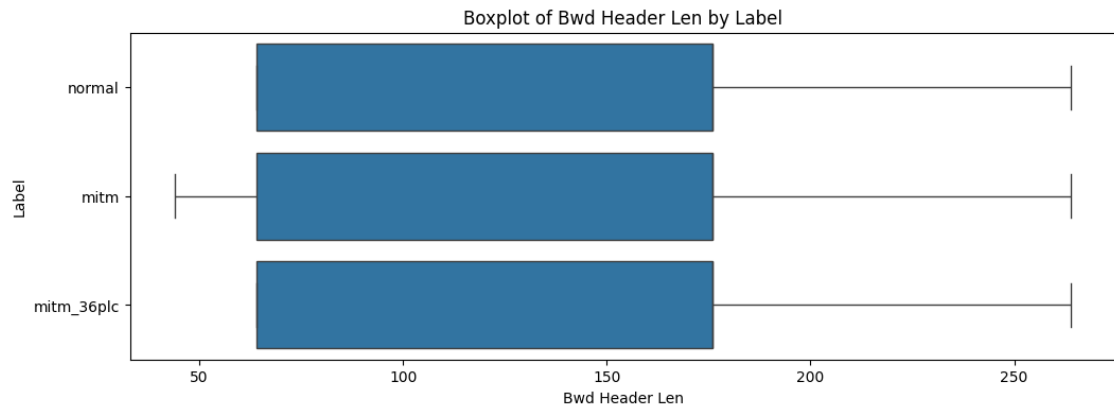
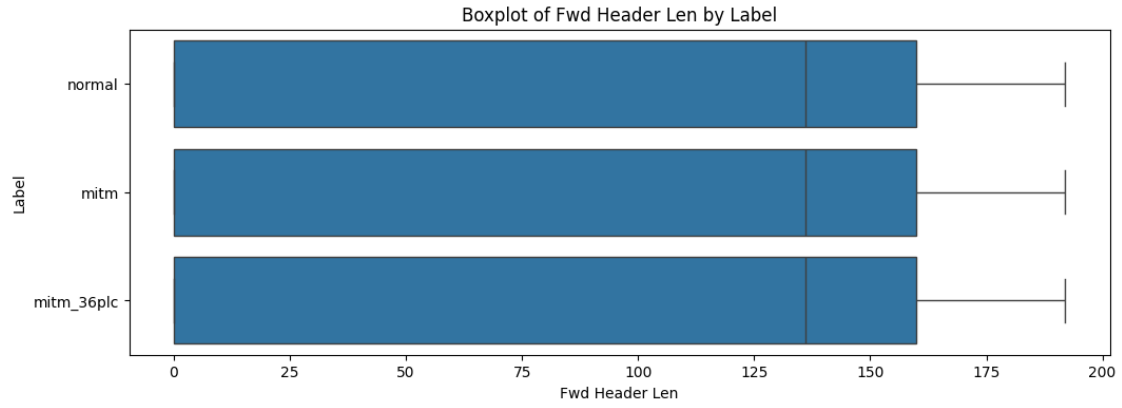


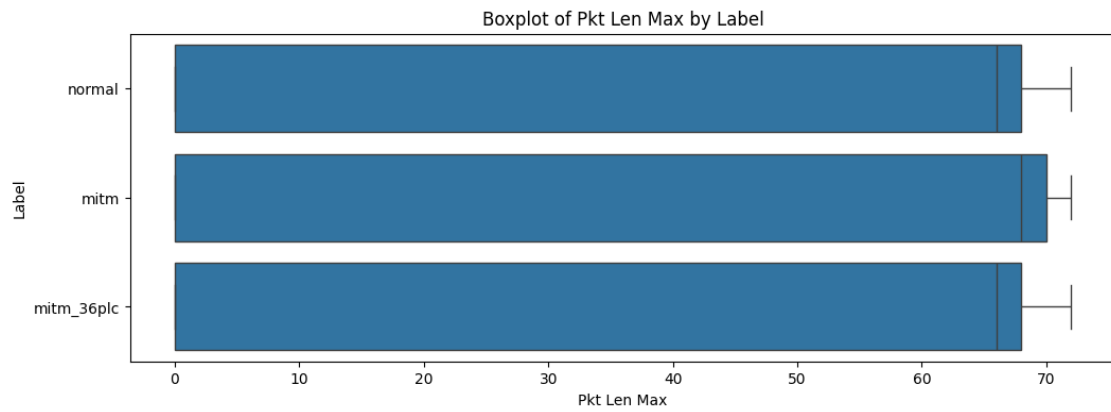
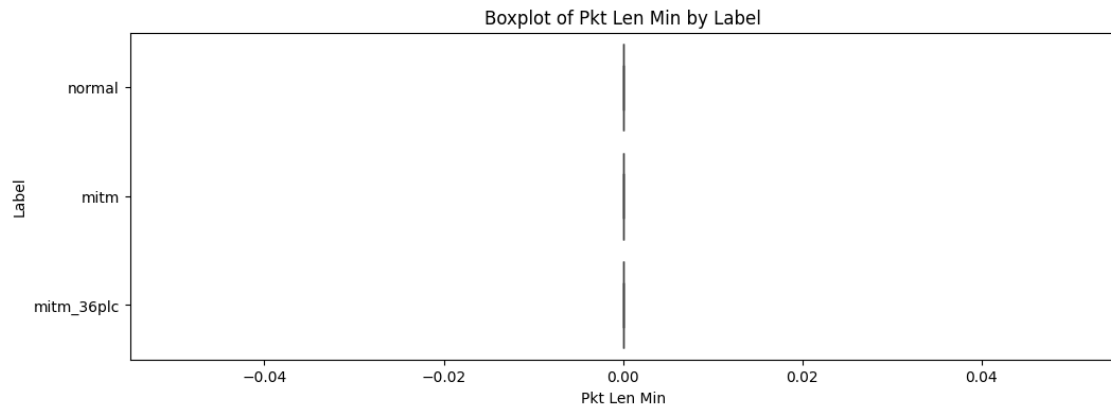
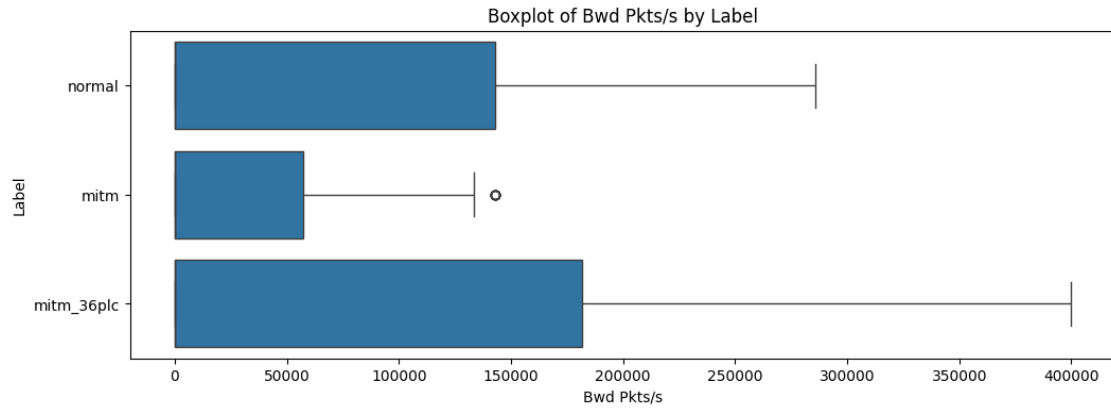


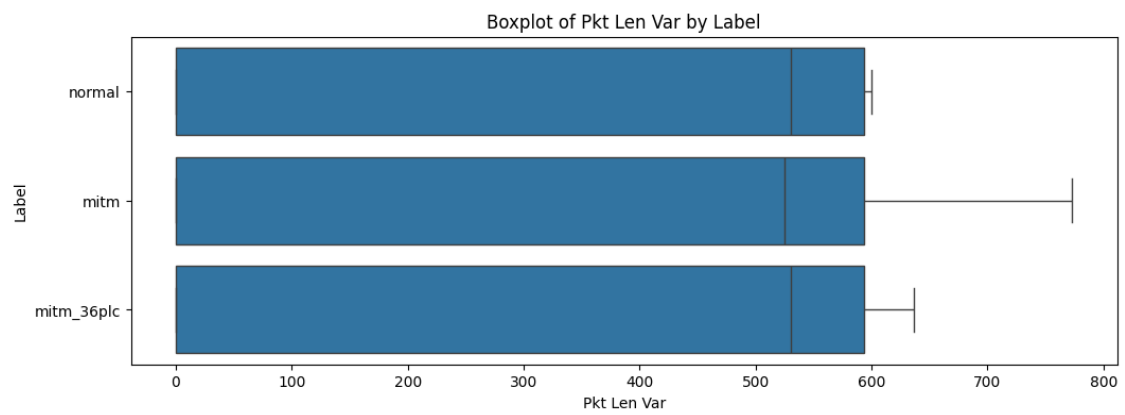
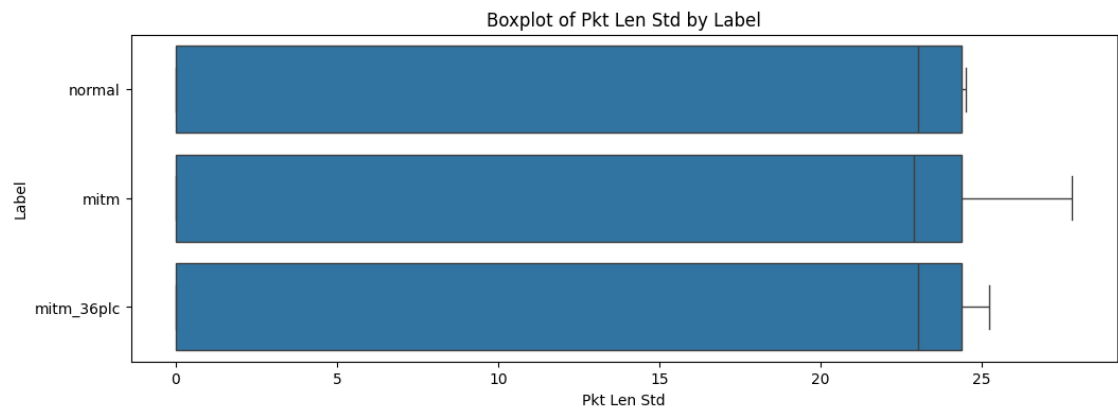
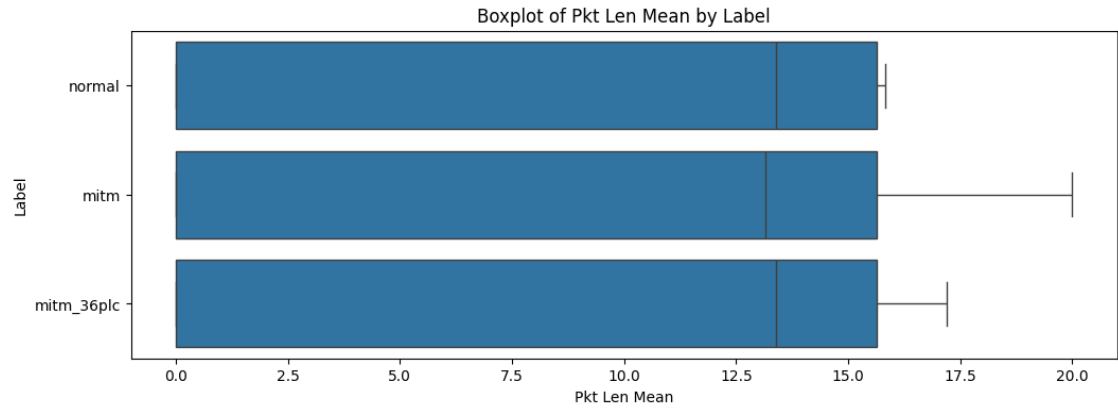


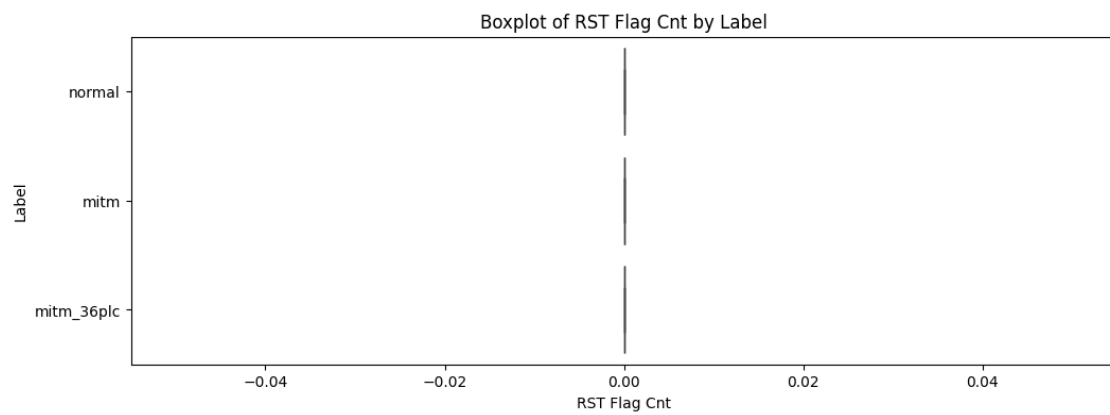
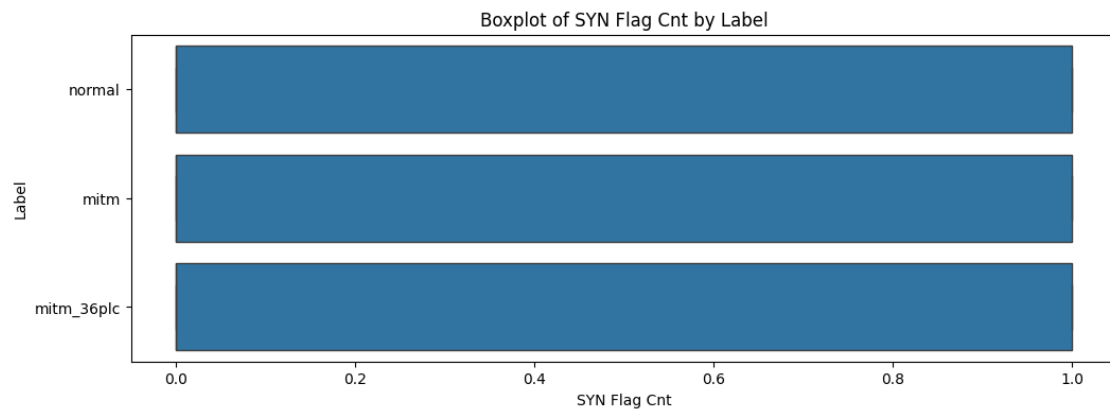
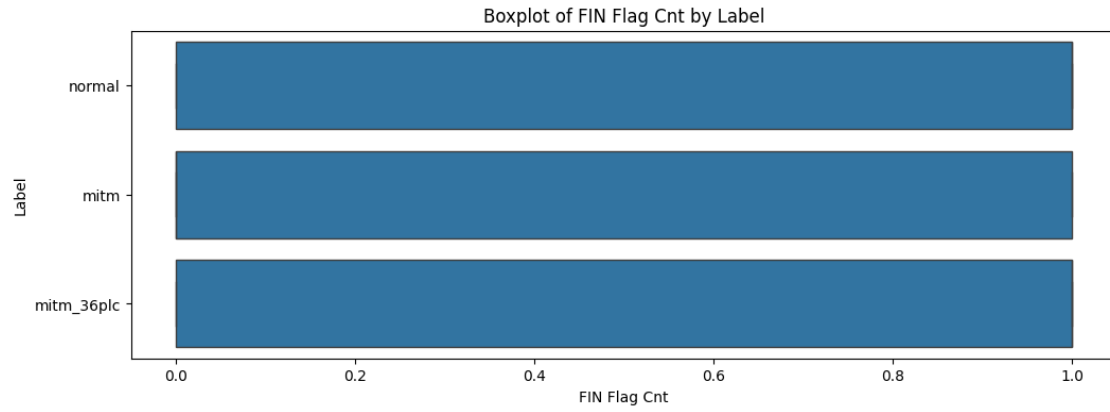


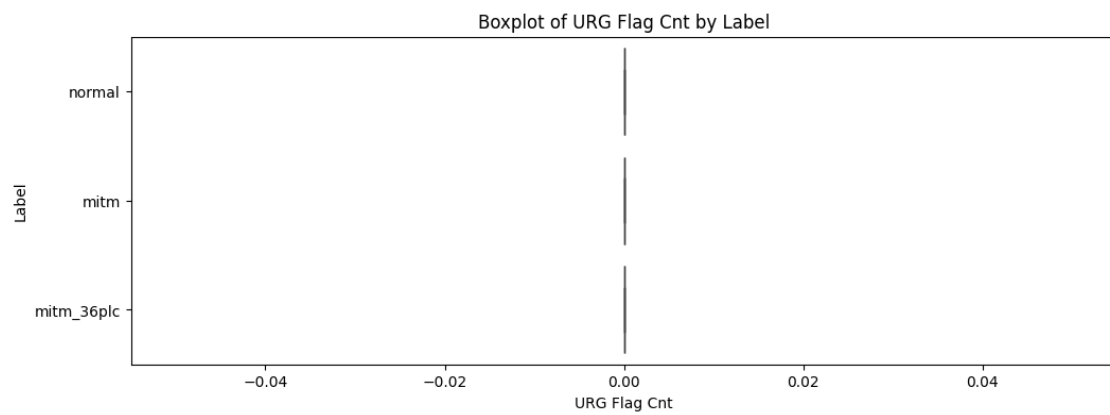
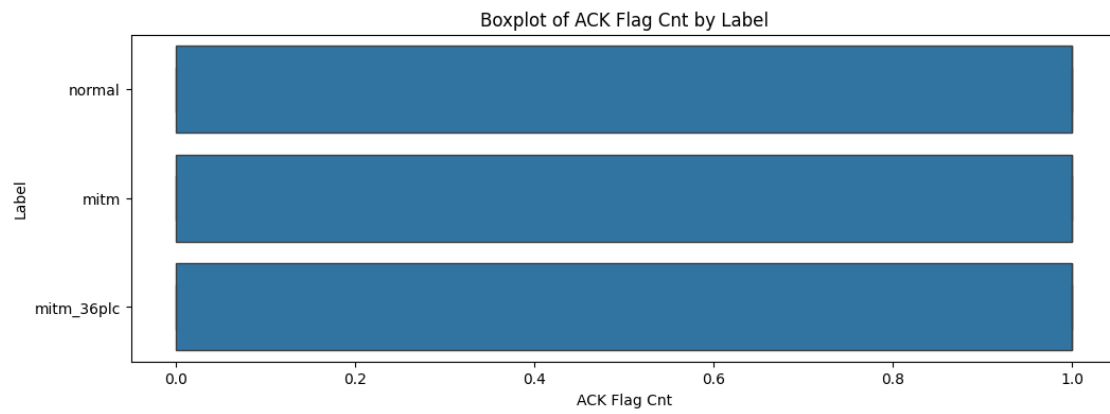
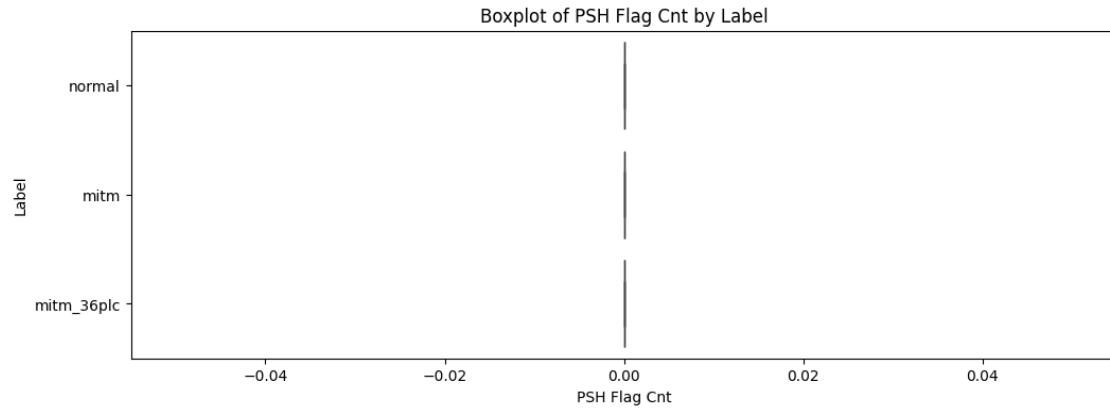


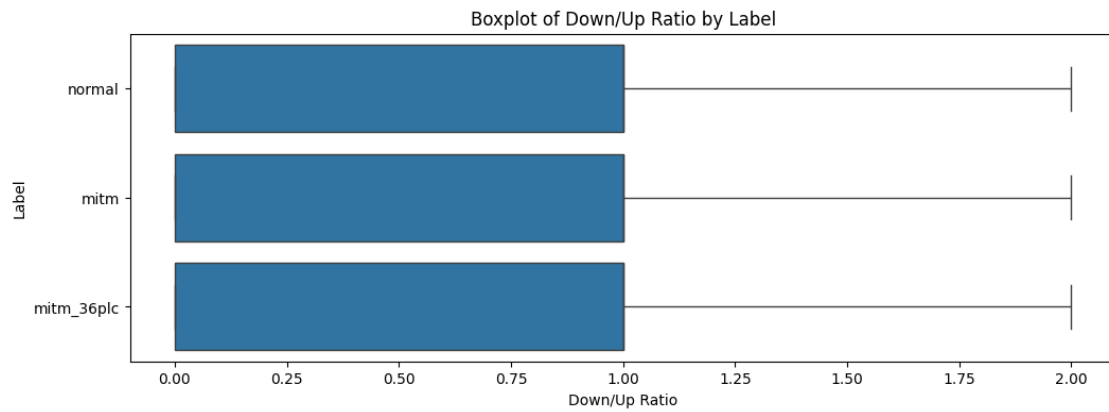
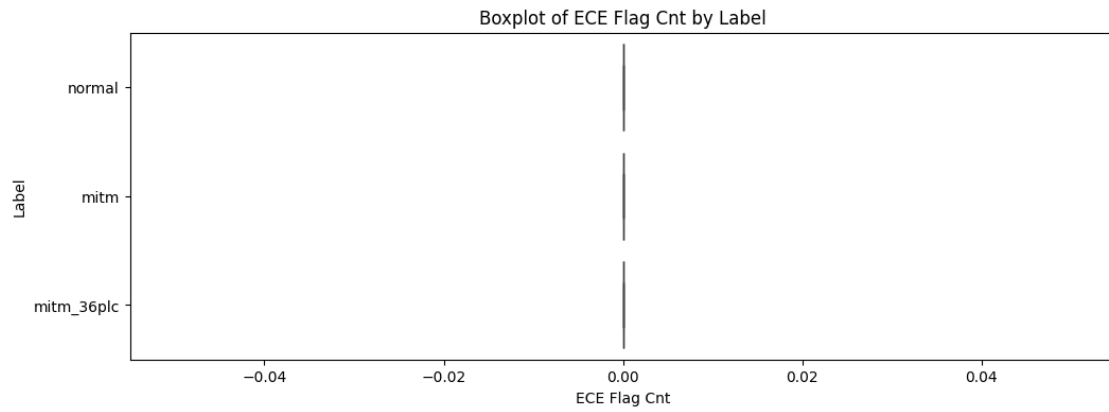
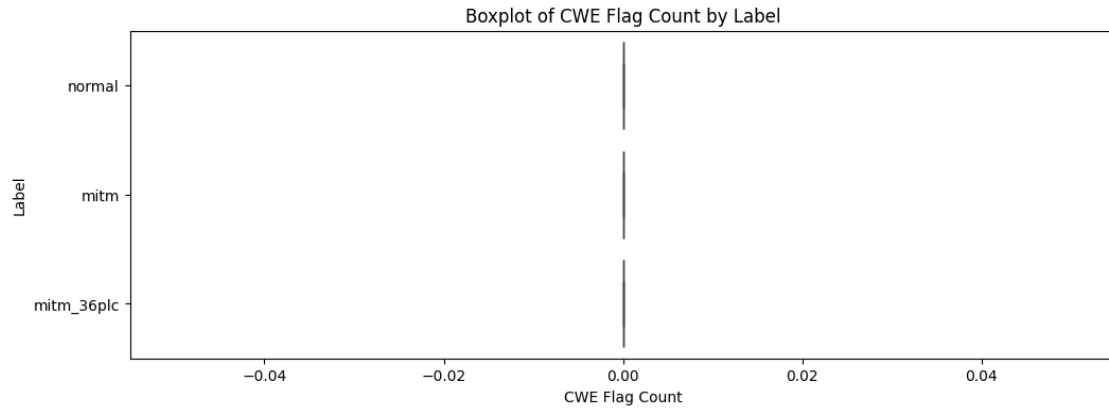


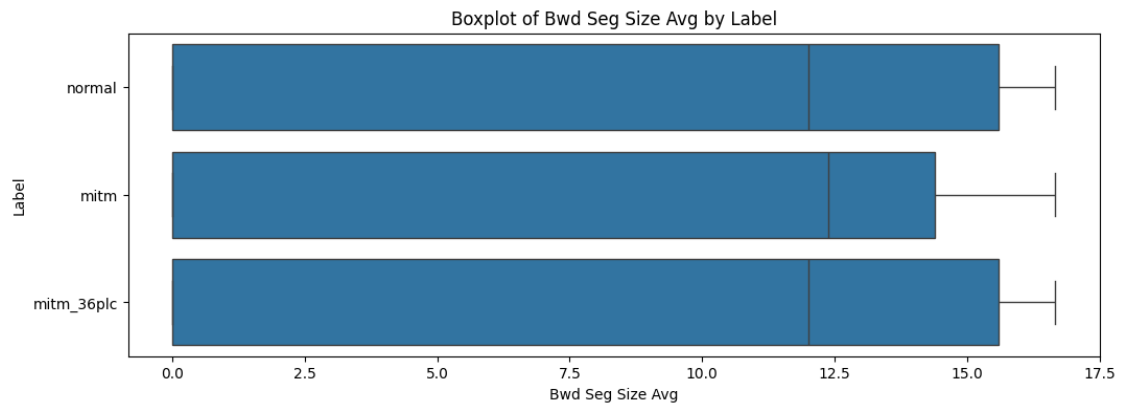
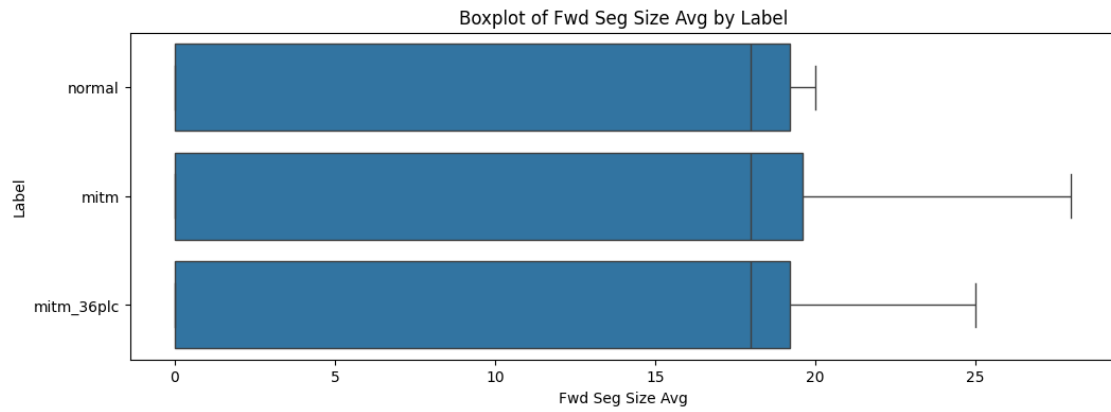
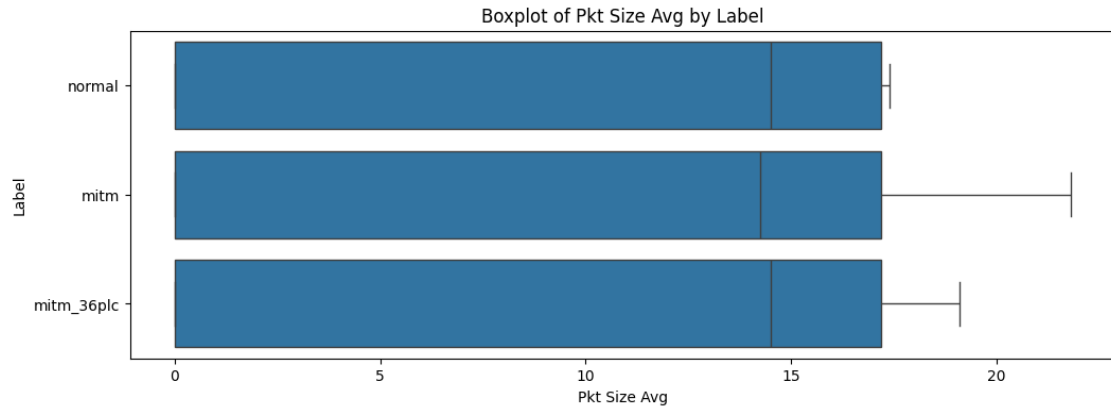


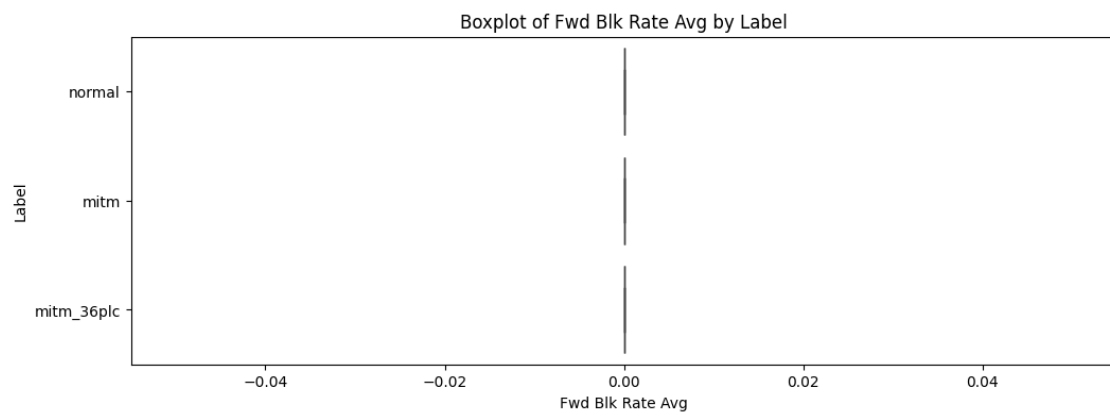
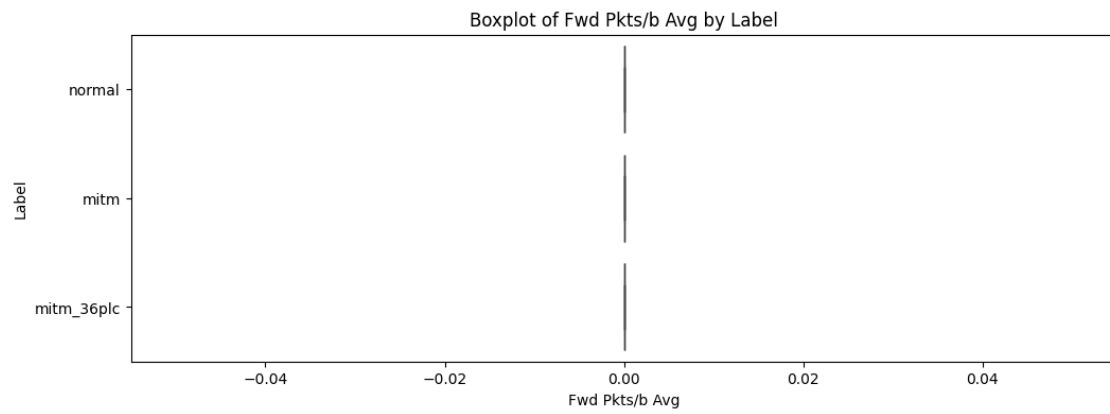
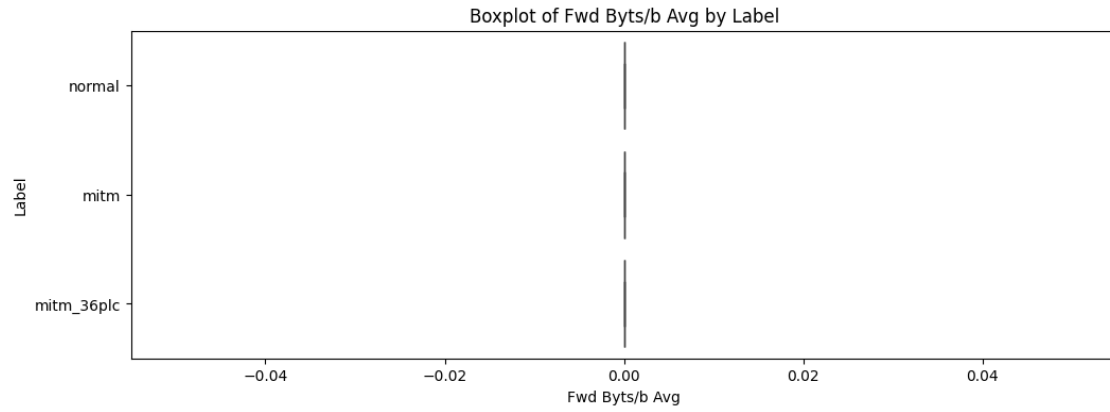


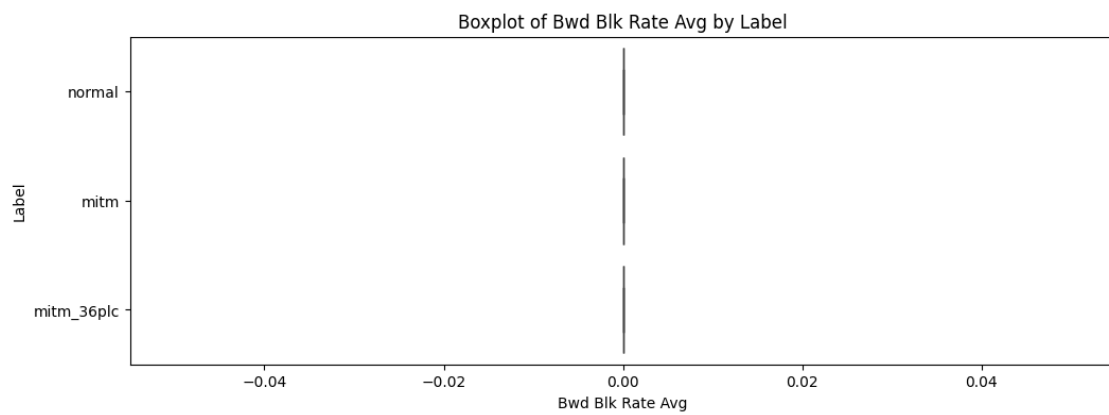
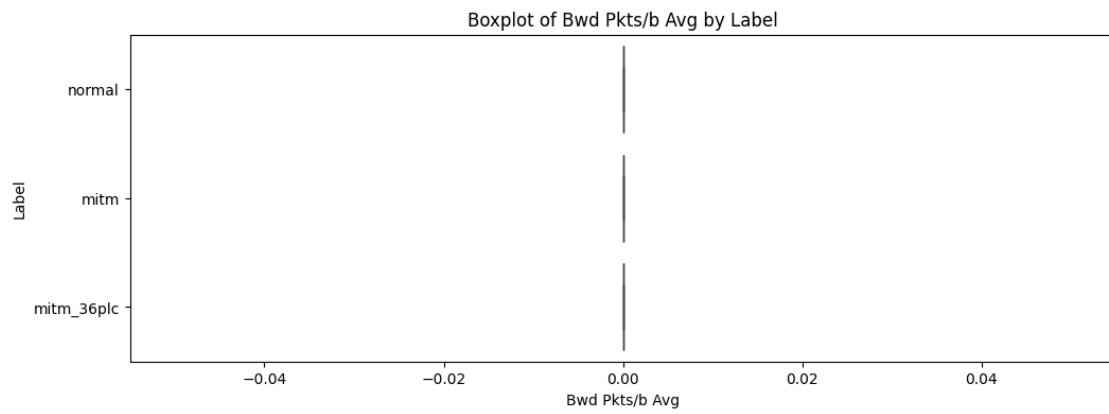
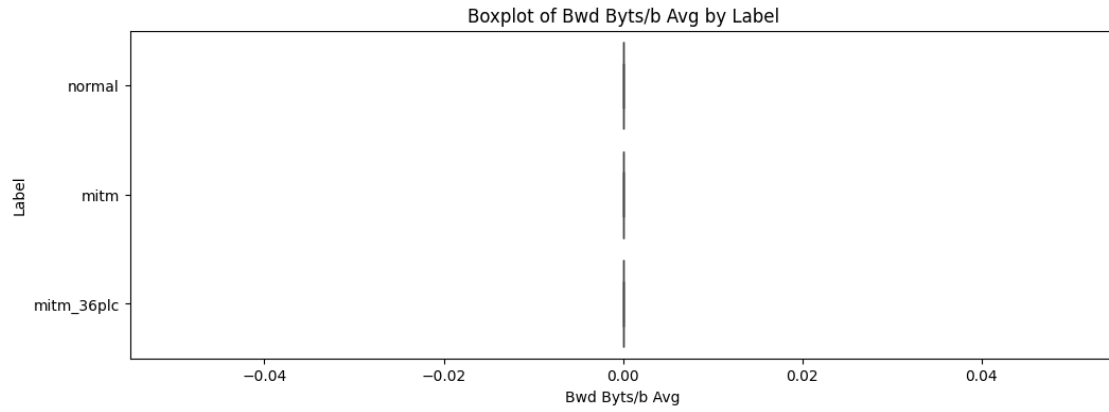


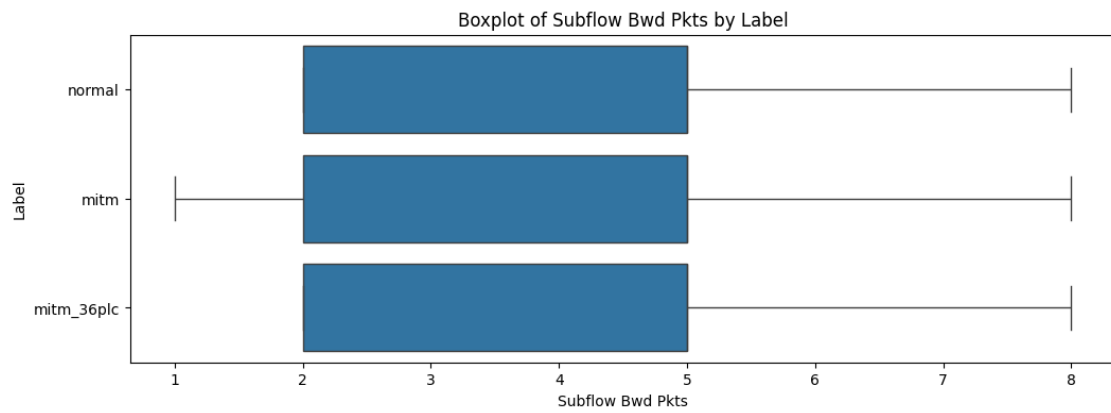
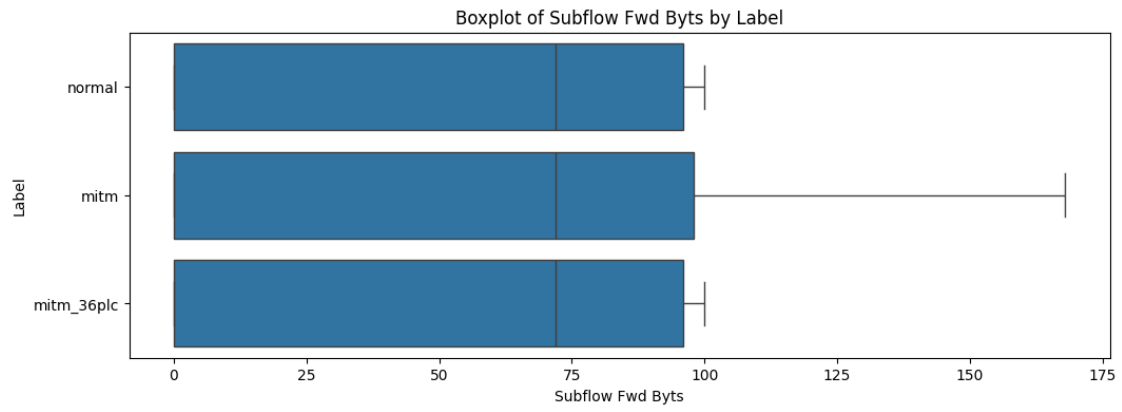
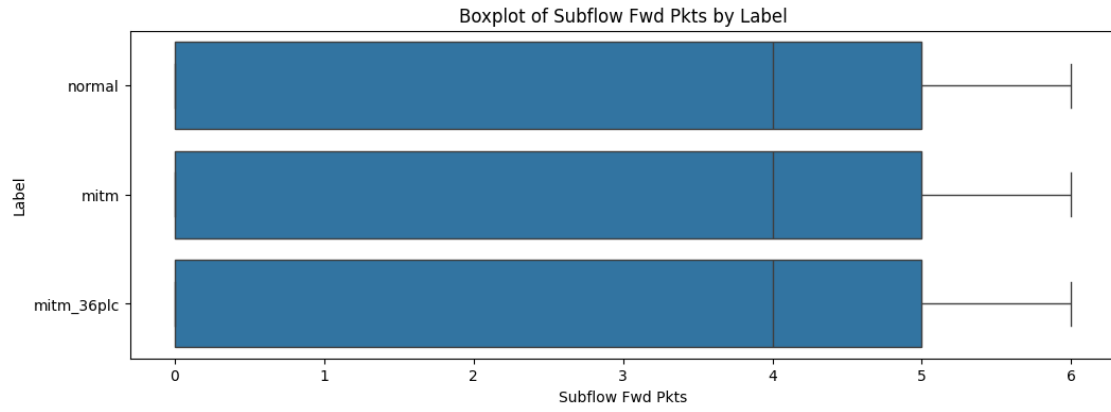


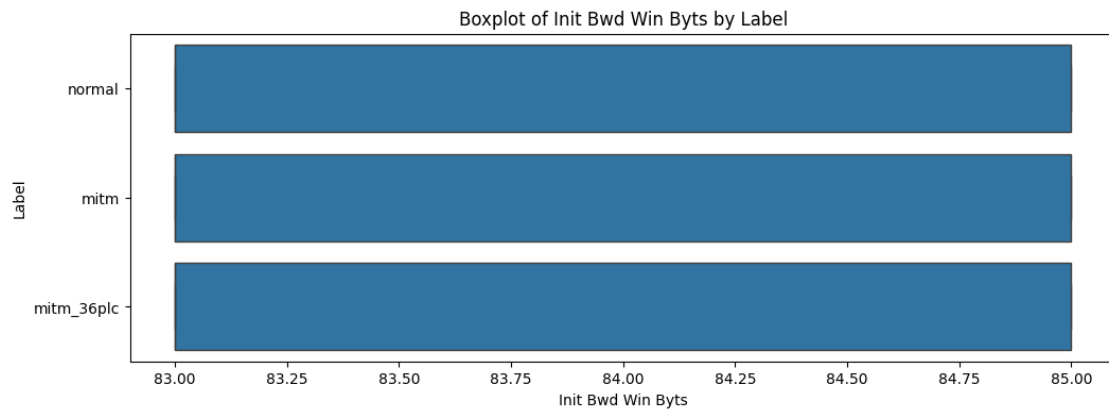
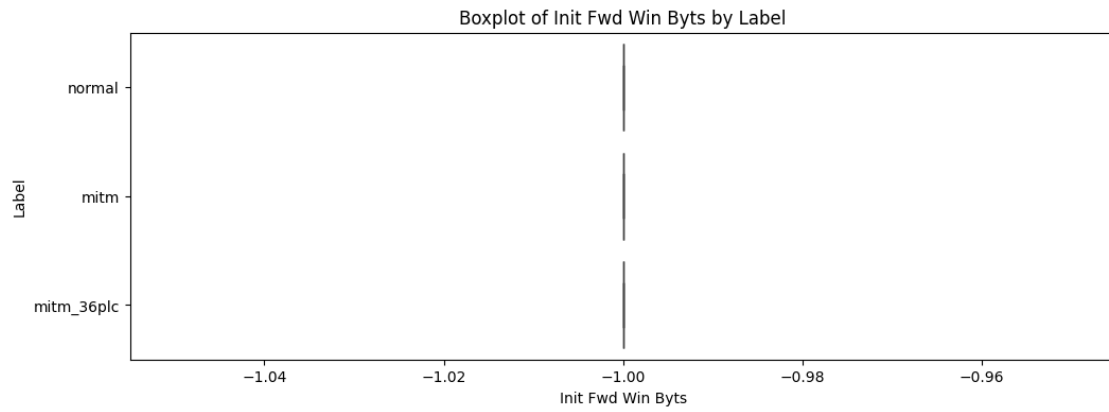
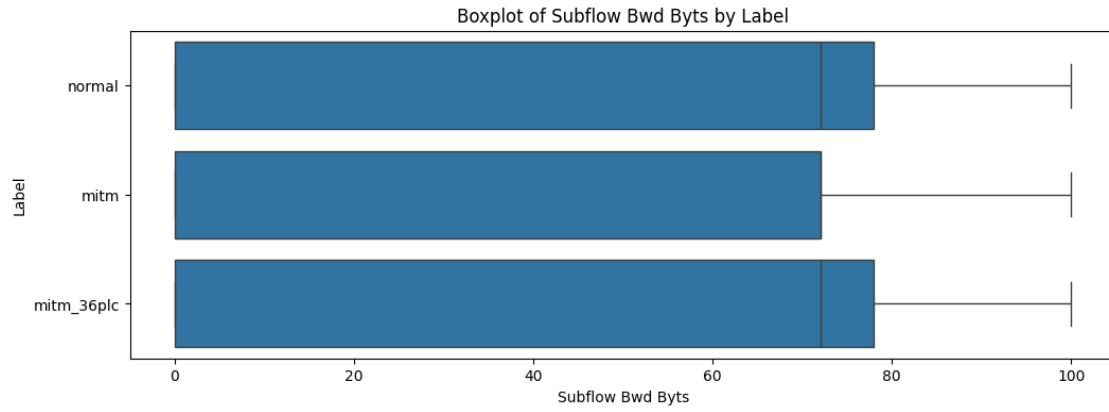


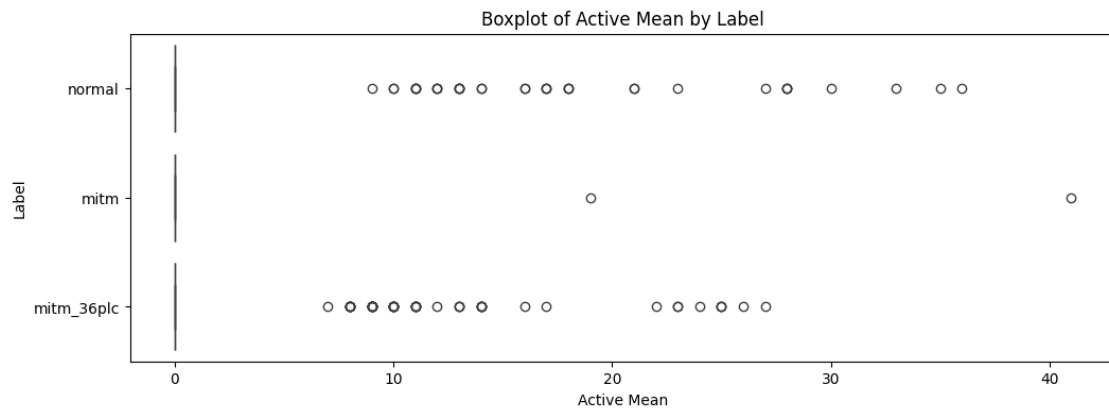
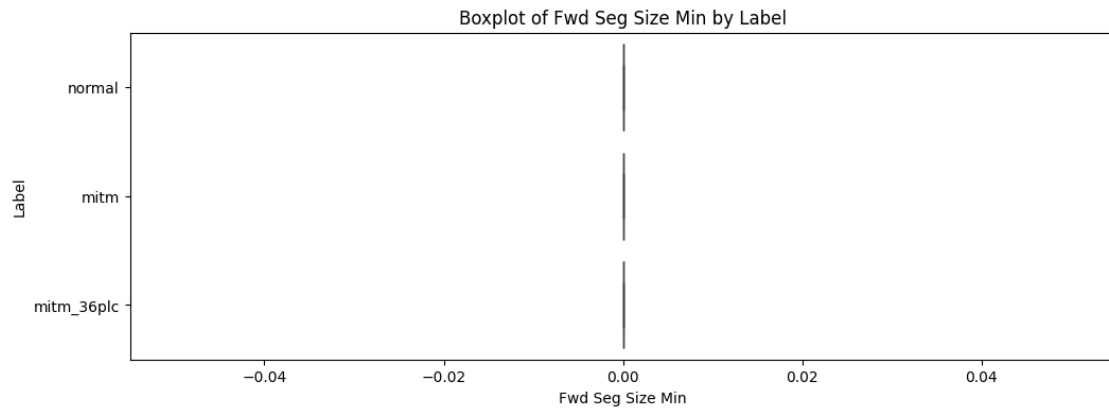
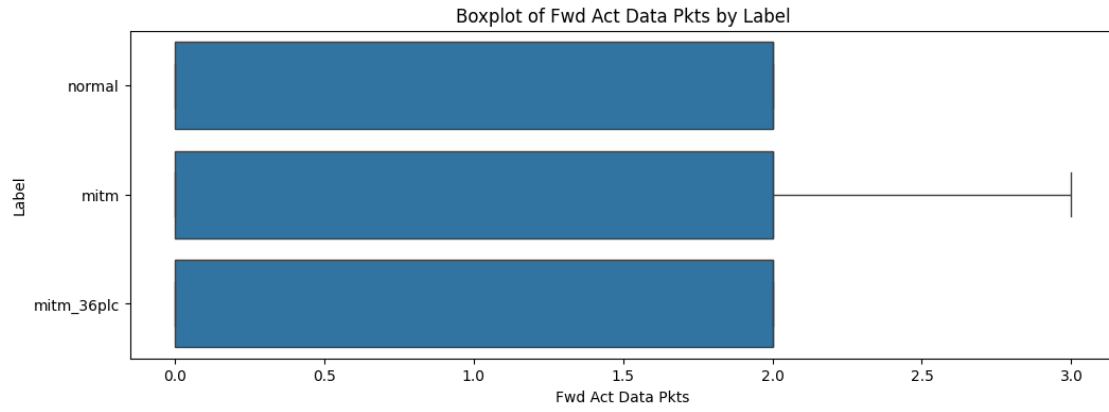


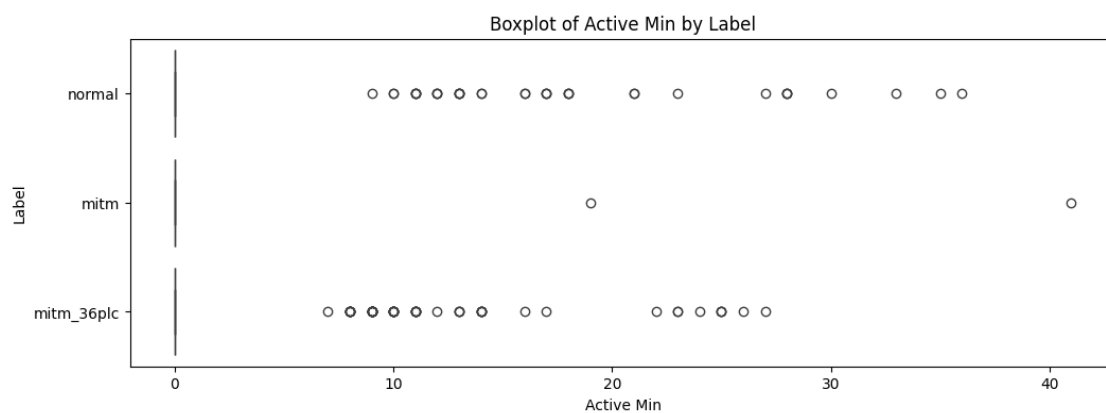
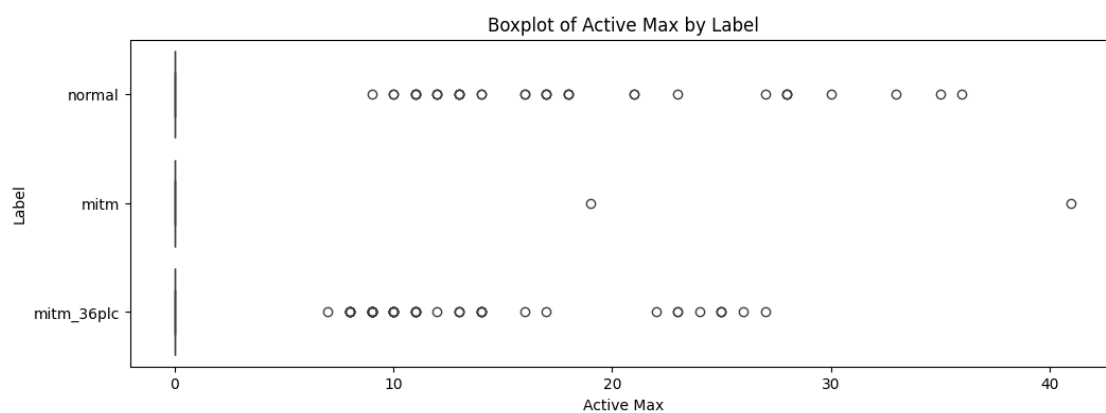
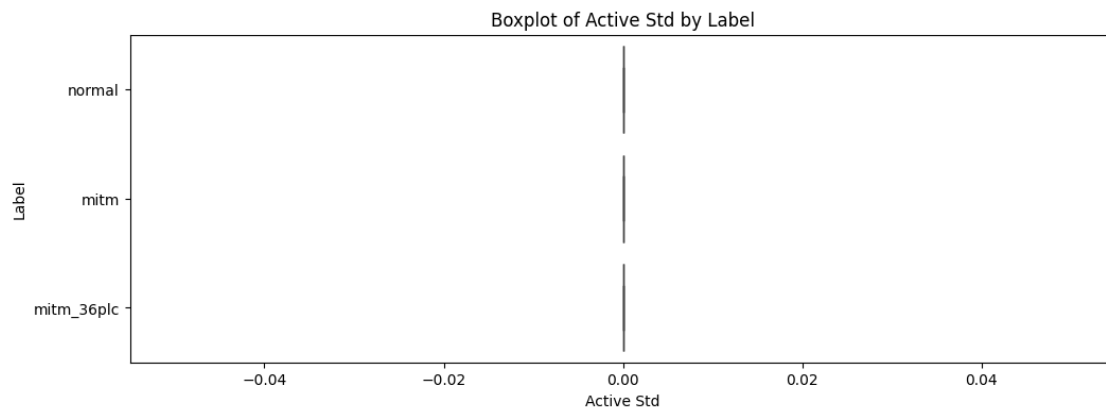


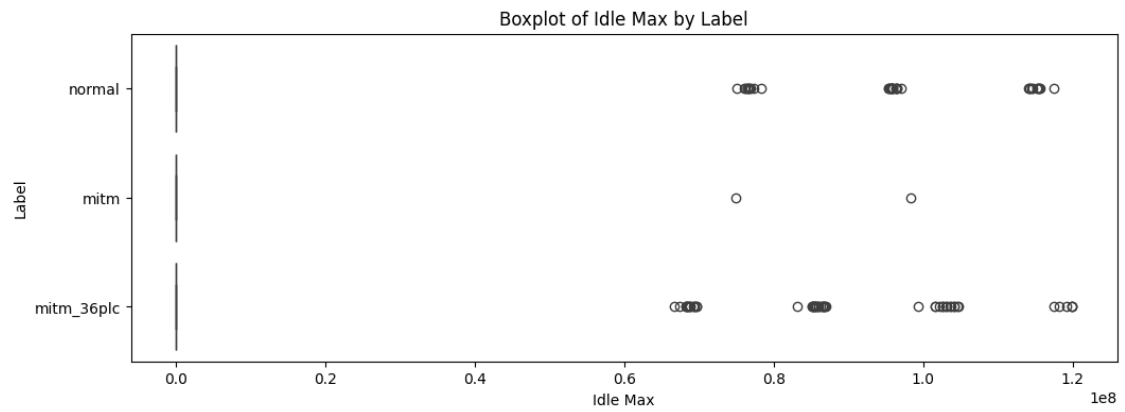
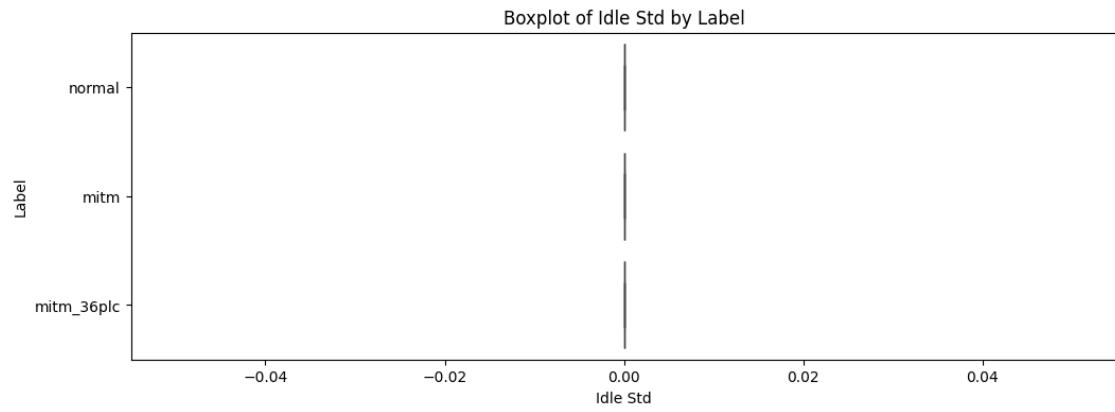
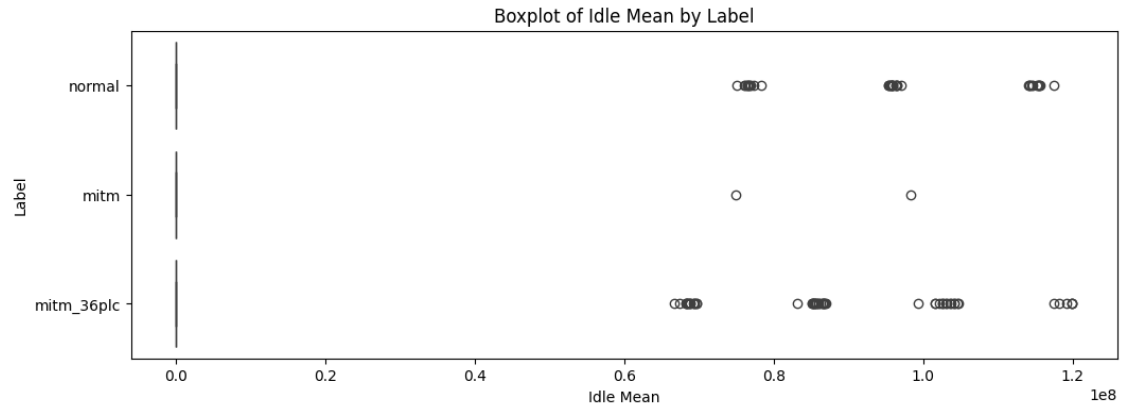


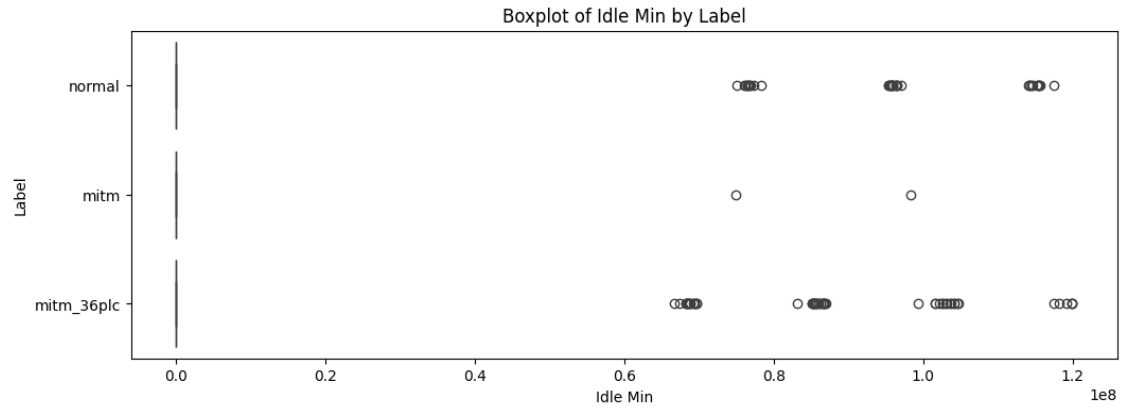




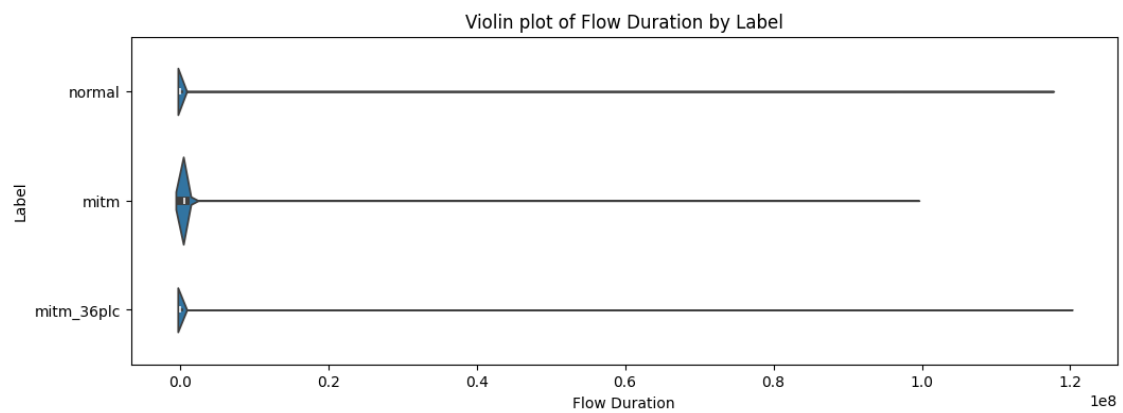
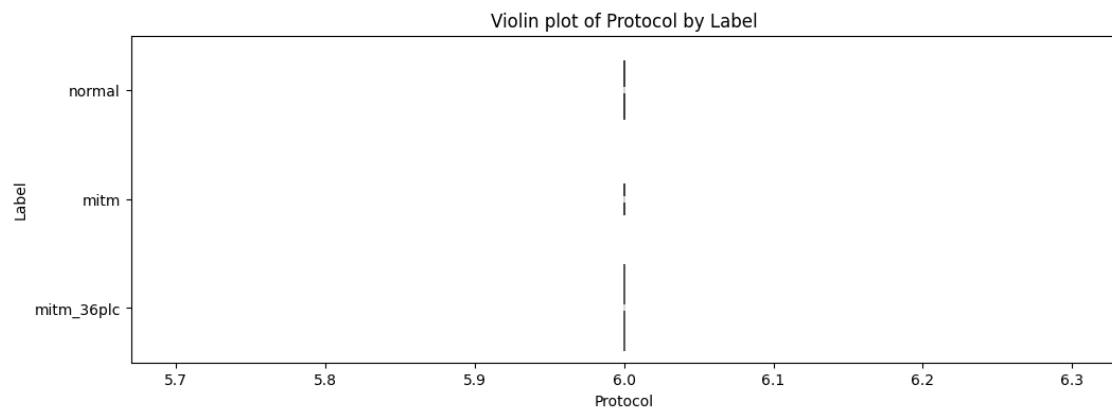


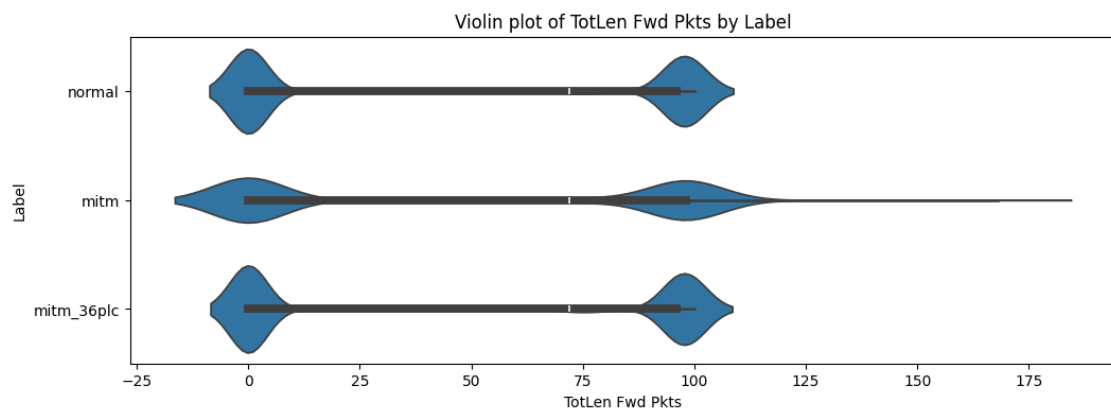
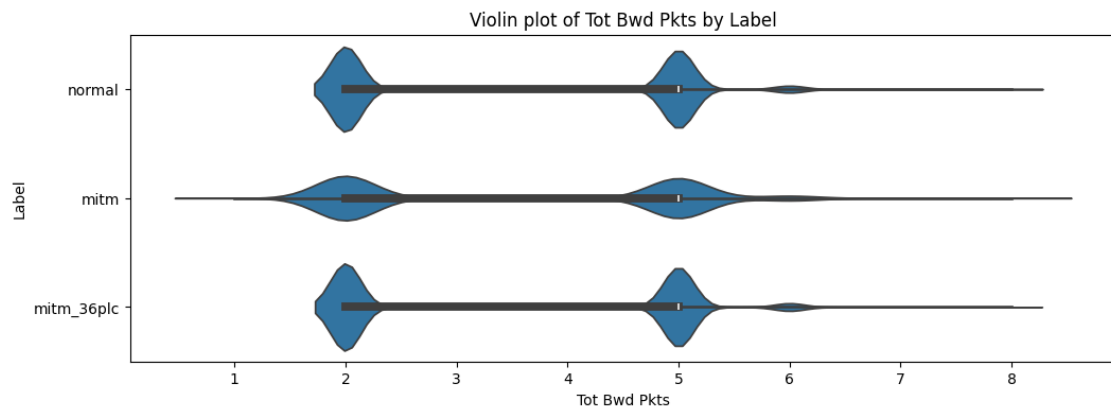
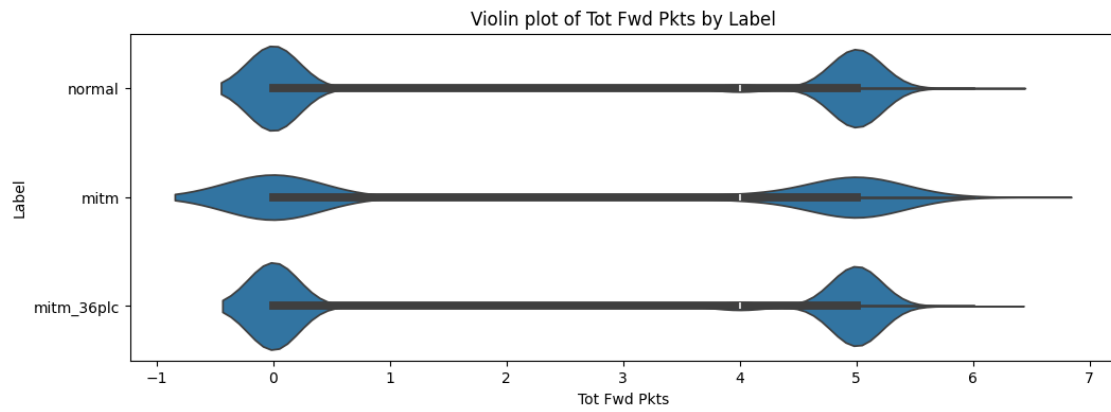


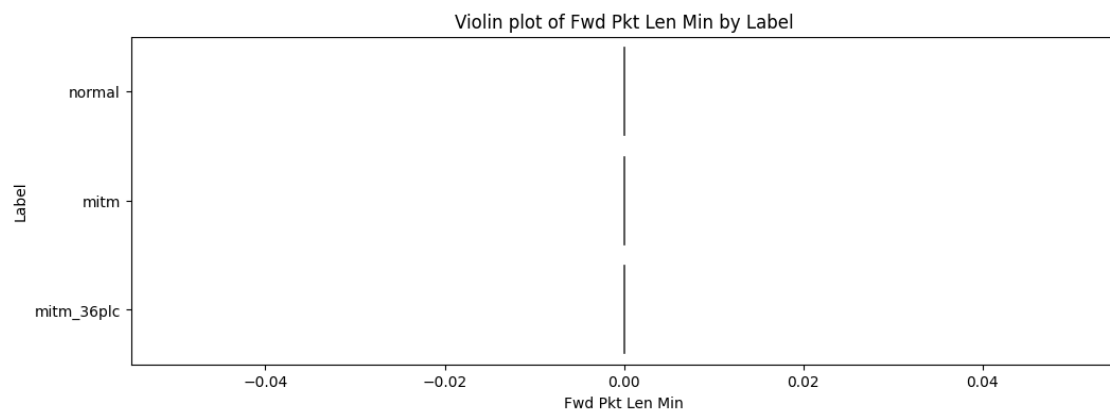
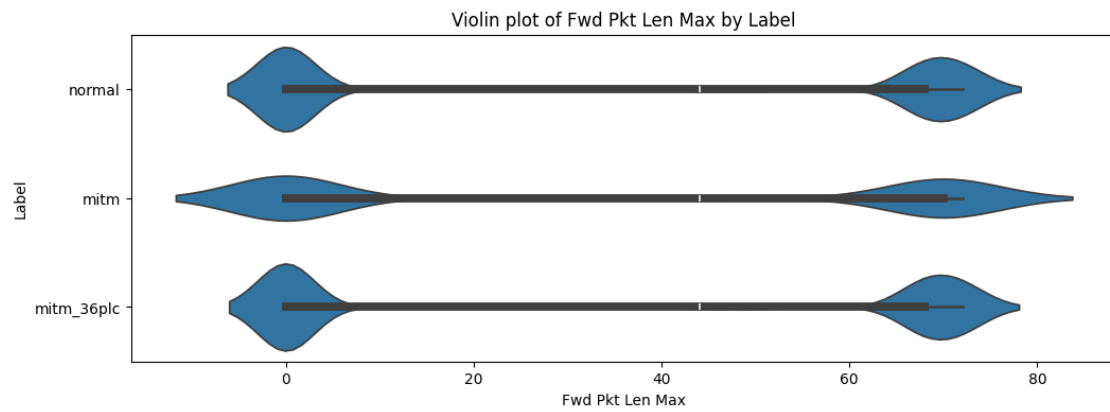
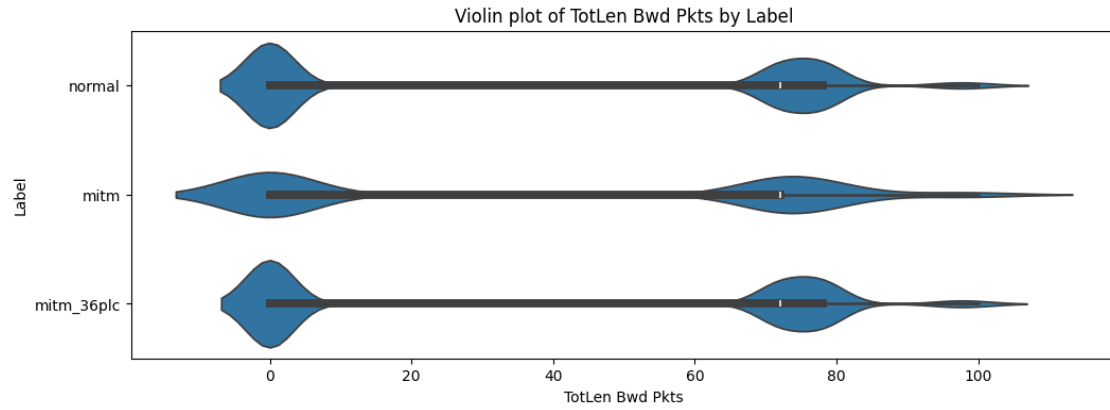


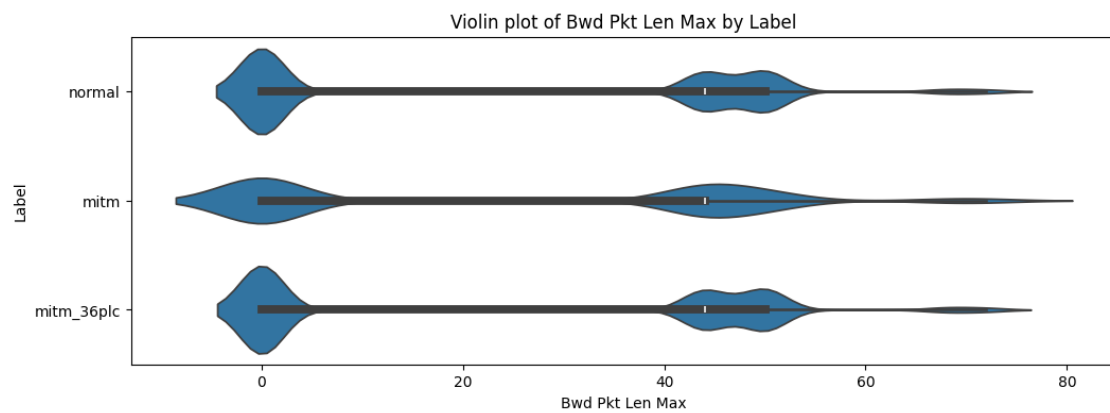
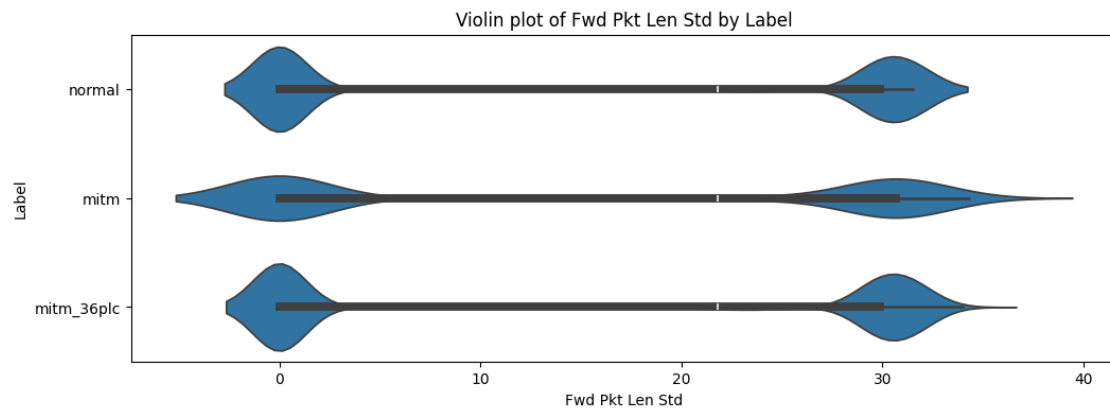
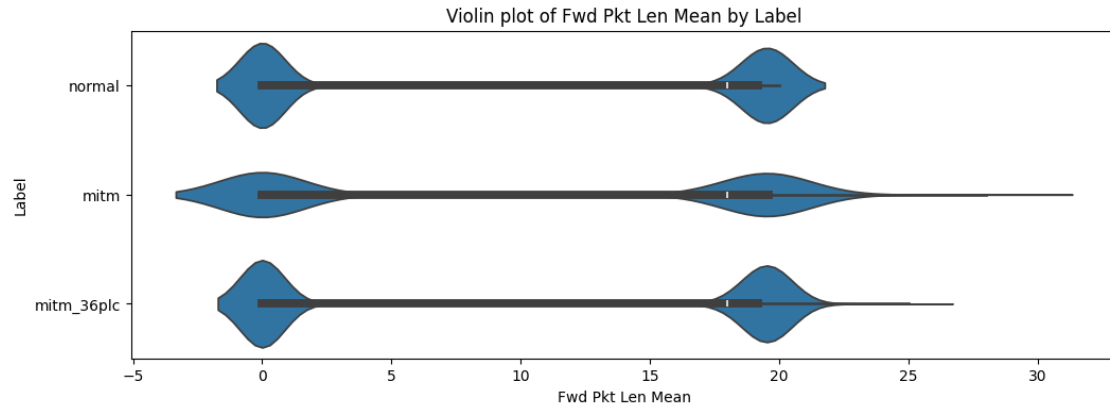


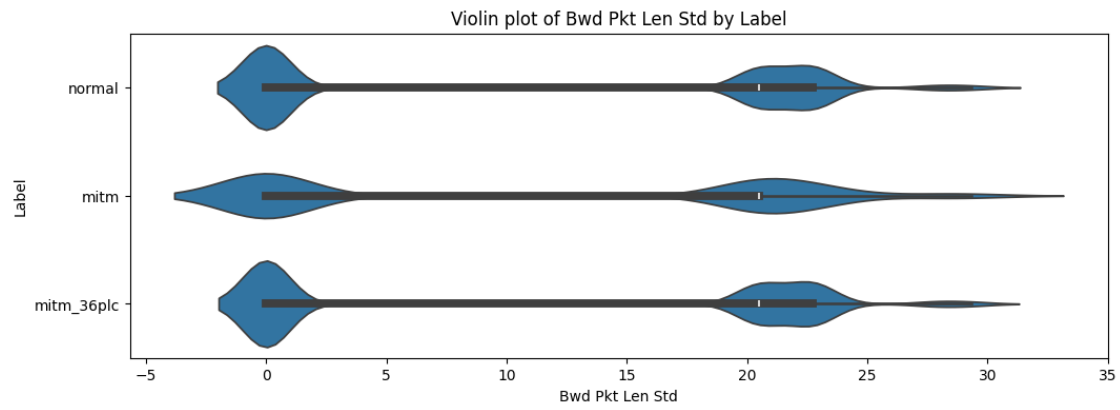
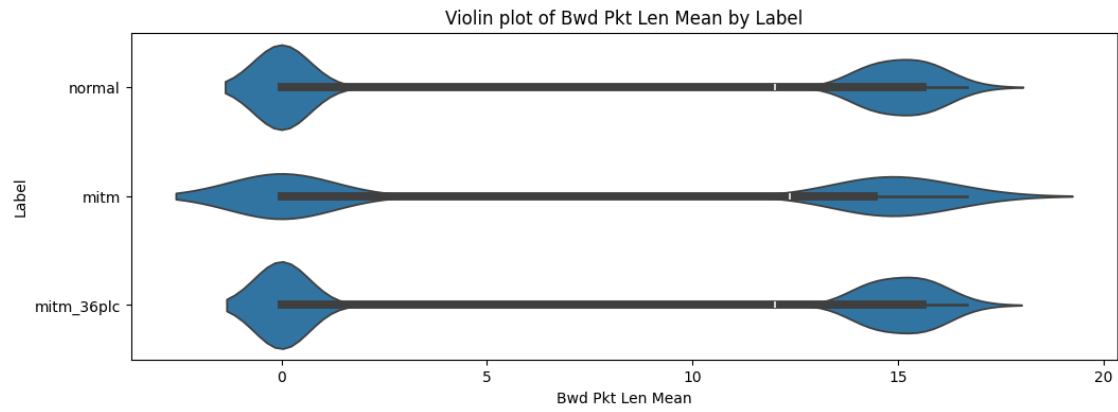
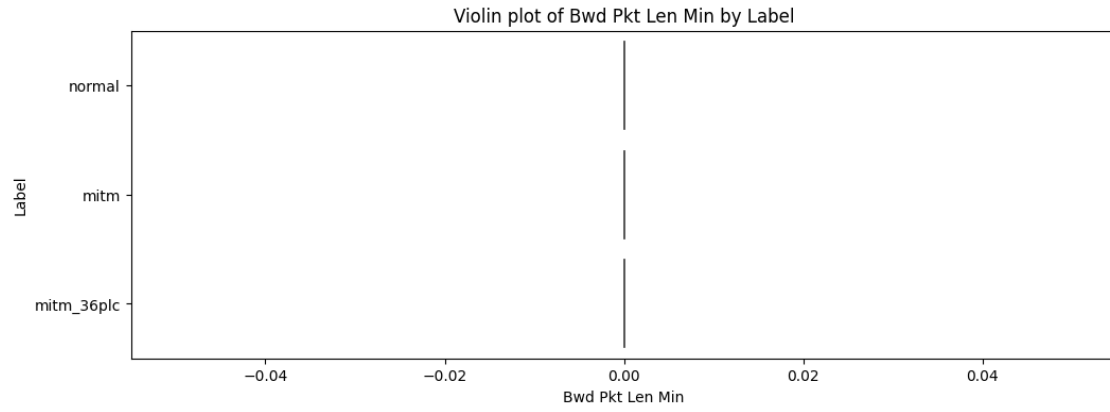
```
[26]: for col in df.select_dtypes(include='number').columns:
plt.figure(figsize=(12, 4))
sns.violinplot(y='Label', x=col, data=df)
plt.title(f'Violin plot of {col} by Label')
plt.show()
```

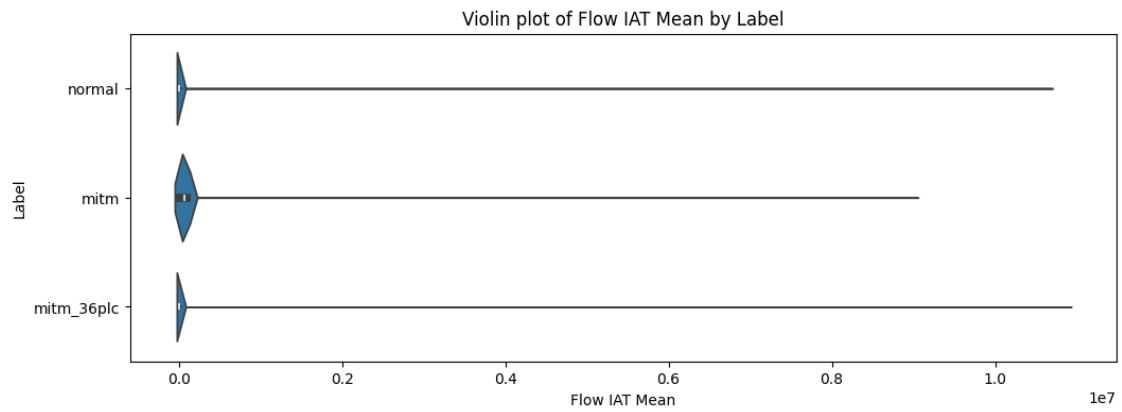
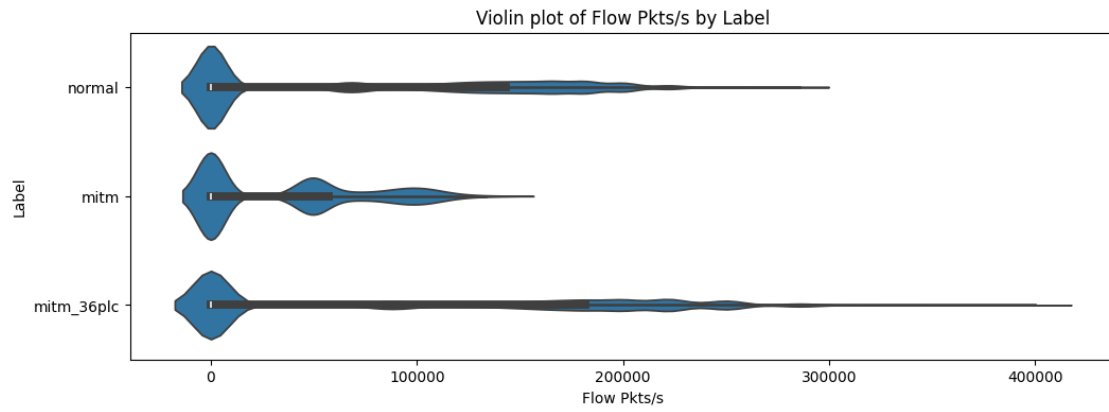
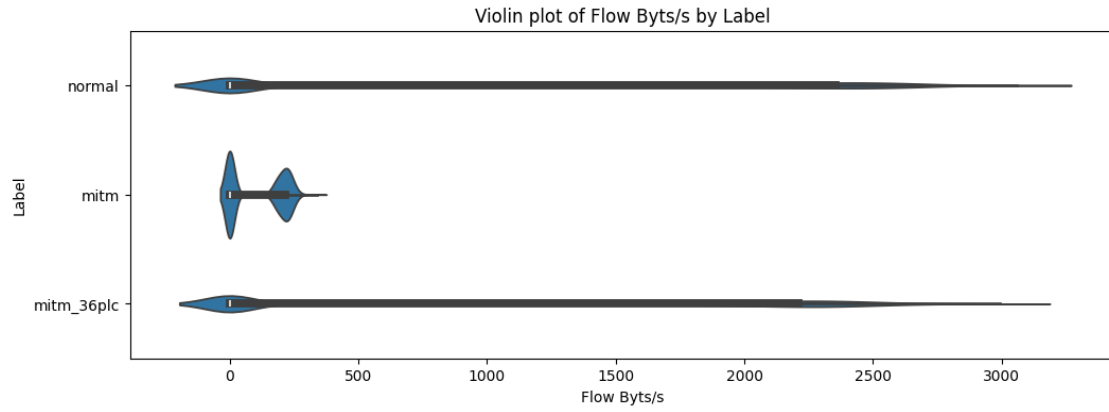


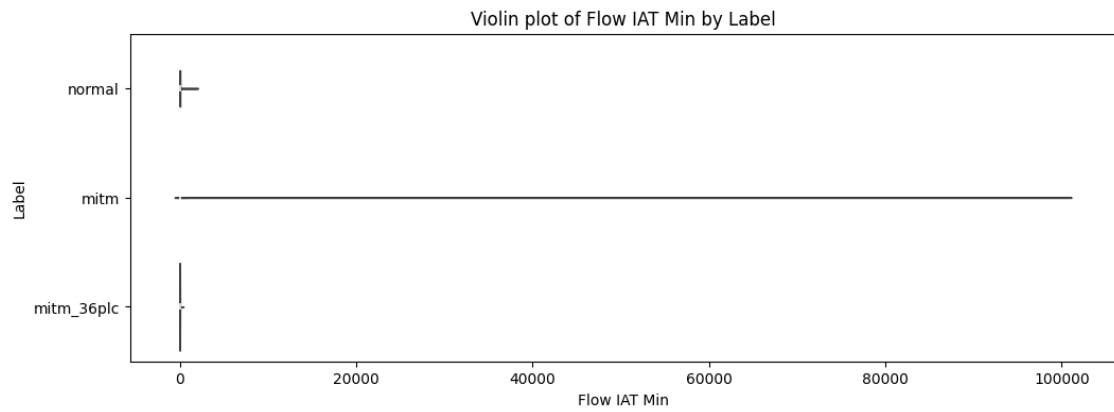
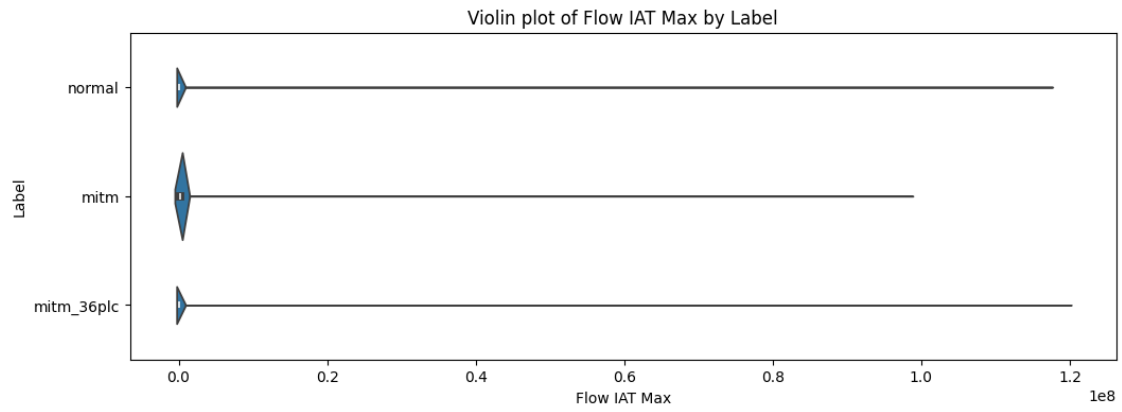
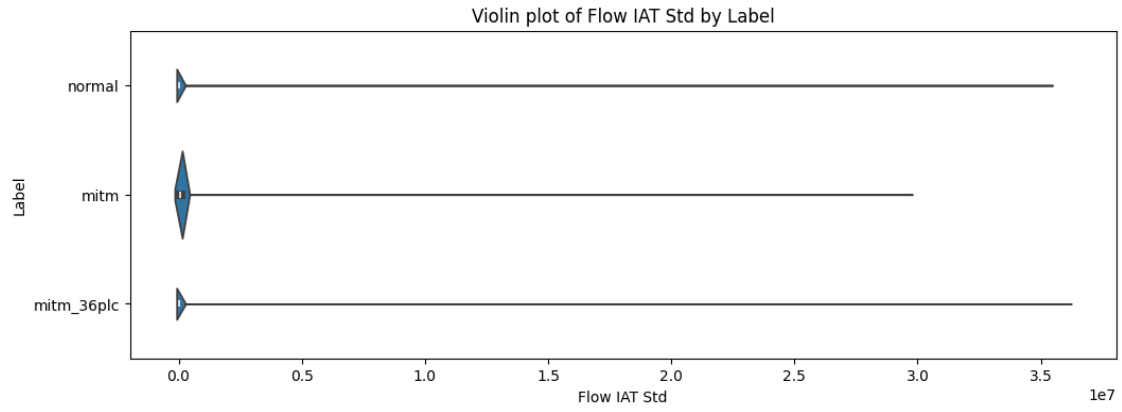


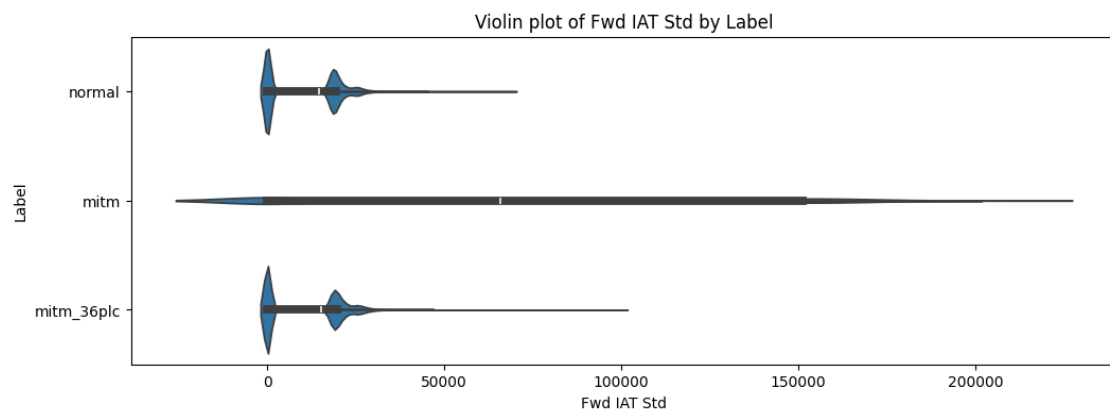
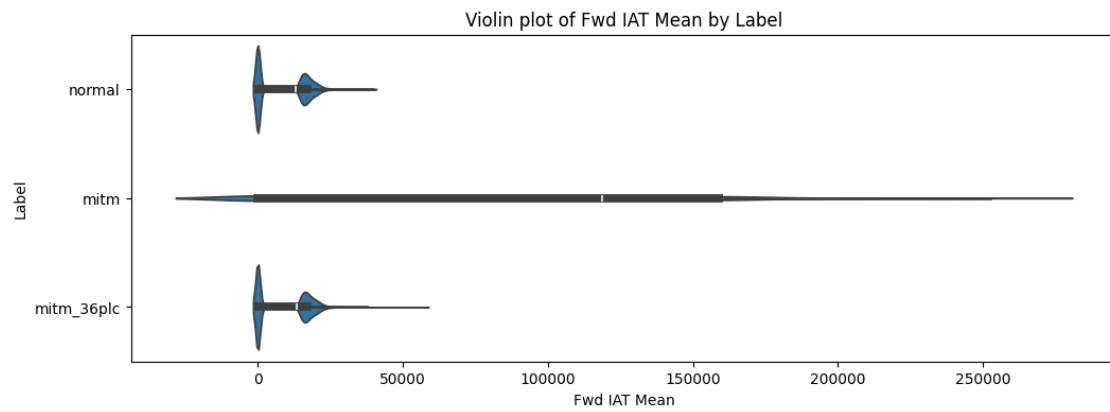
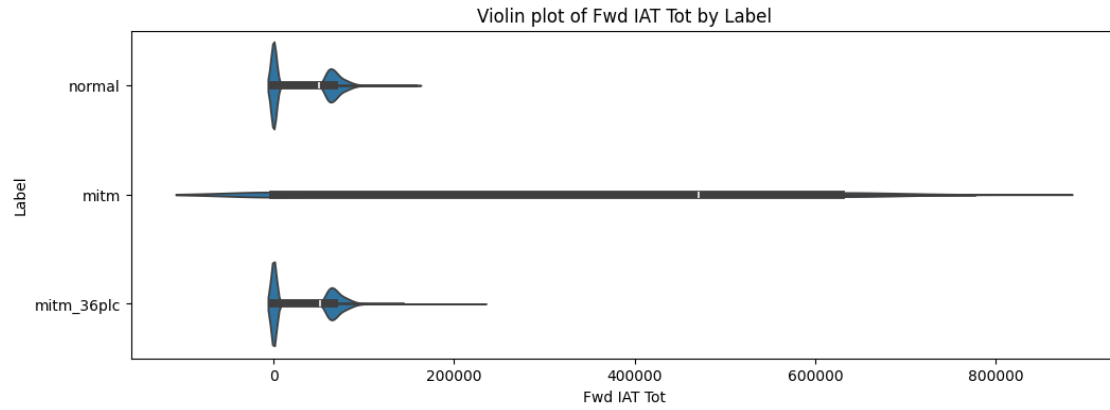


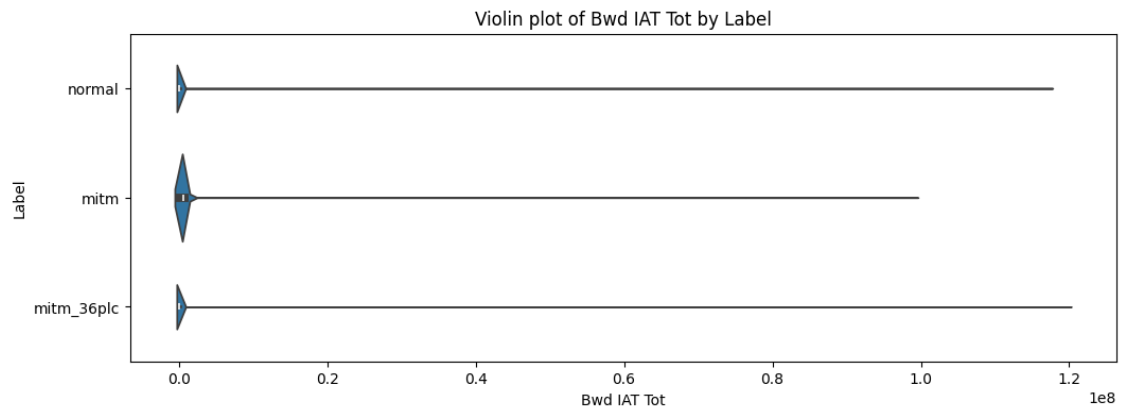
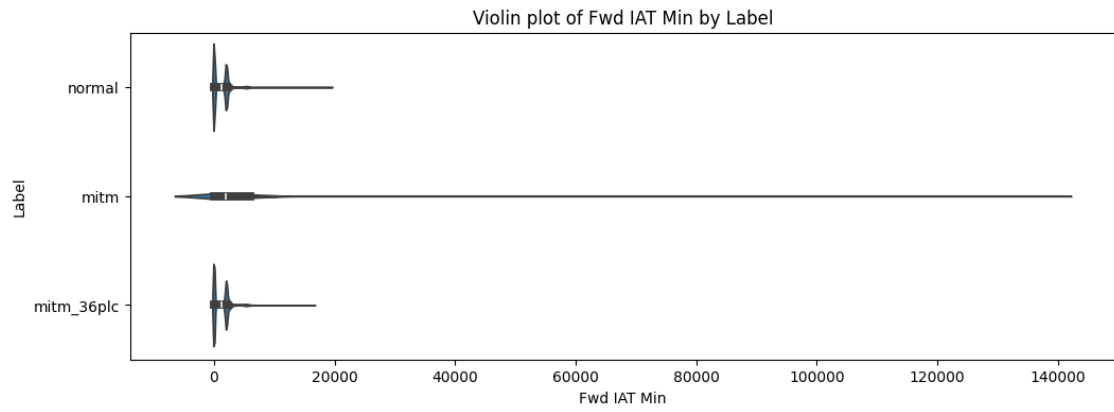
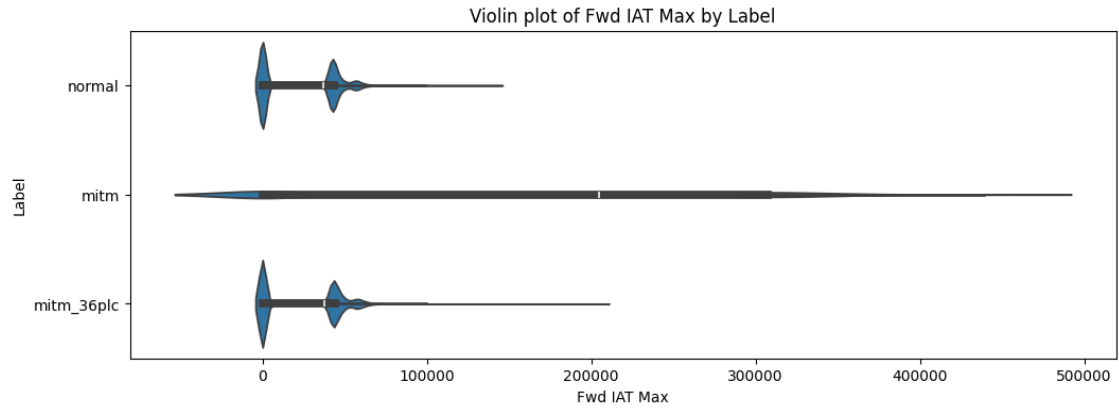


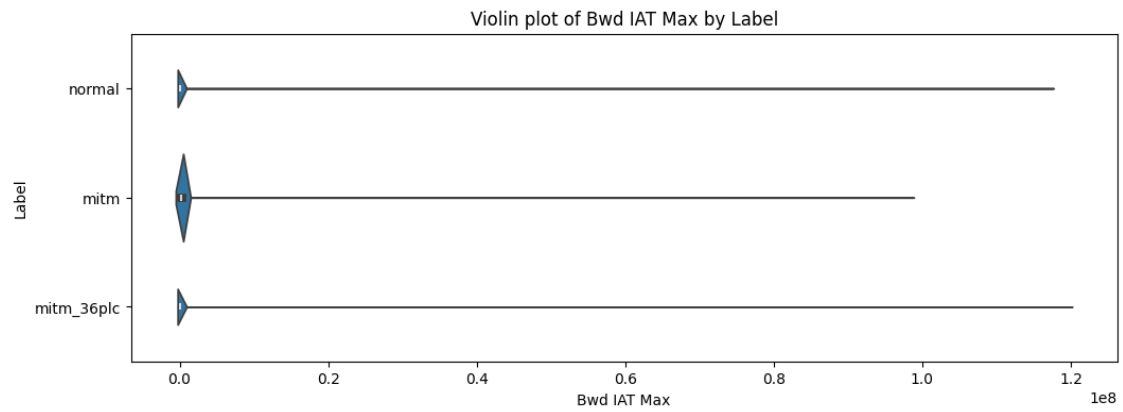
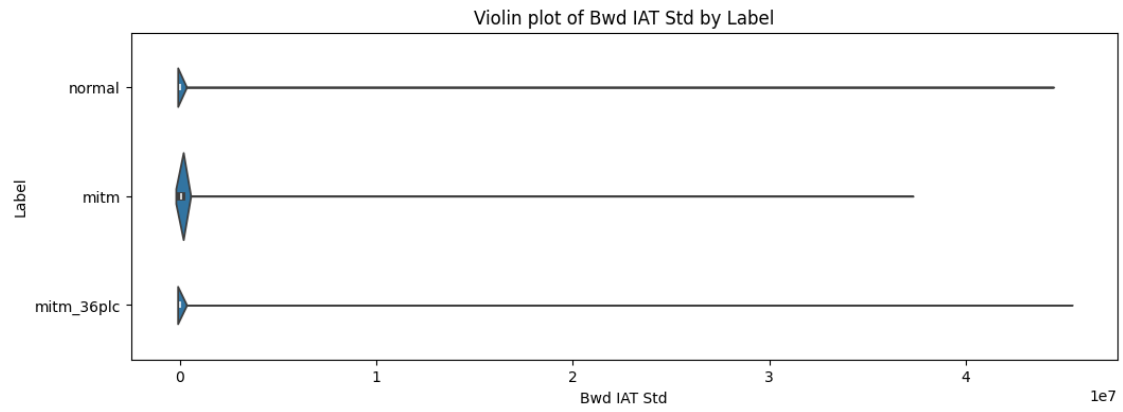
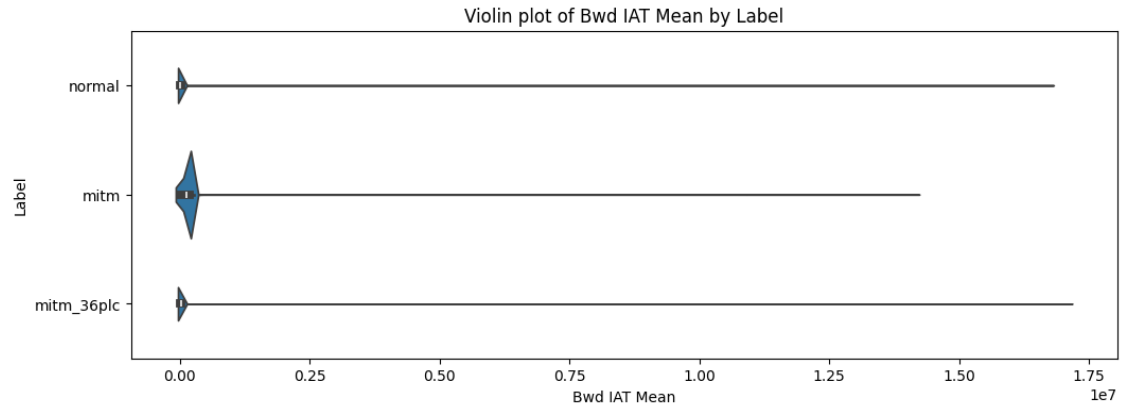


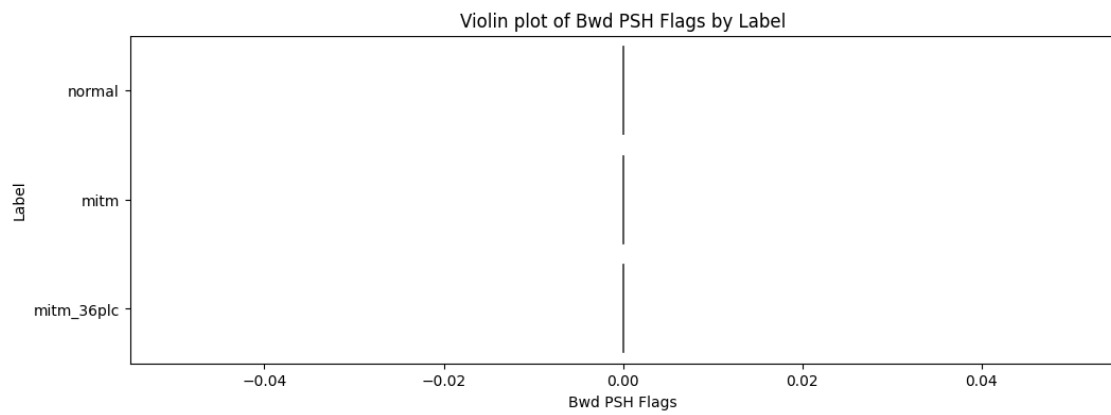
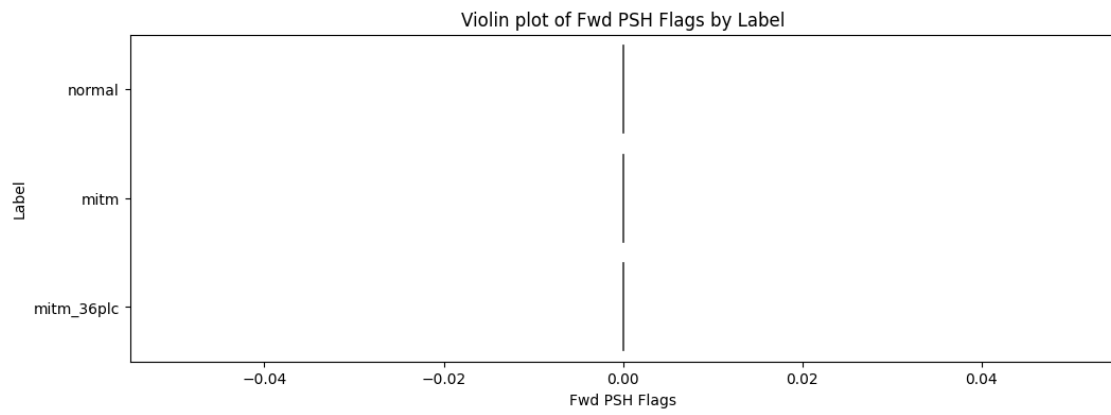
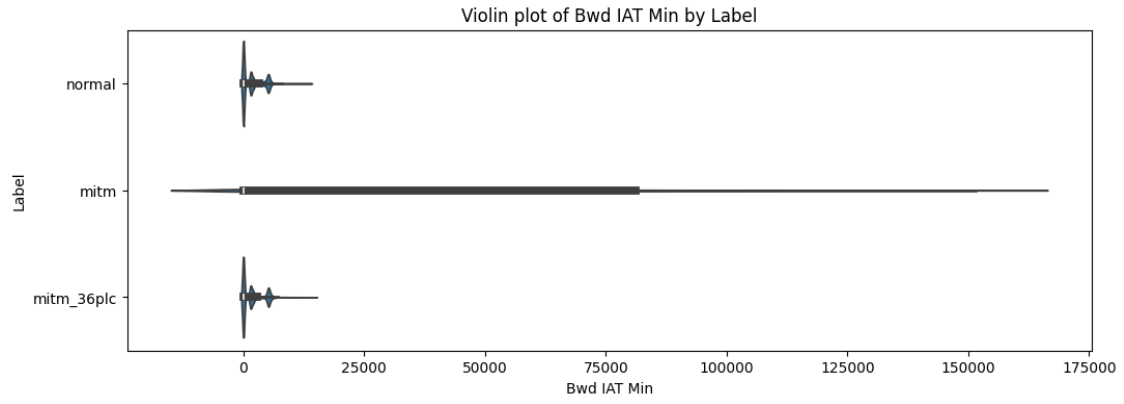


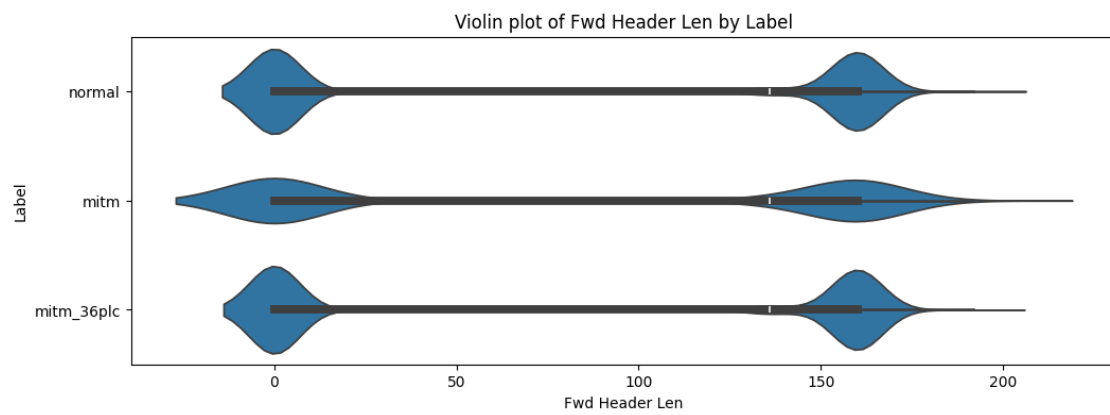
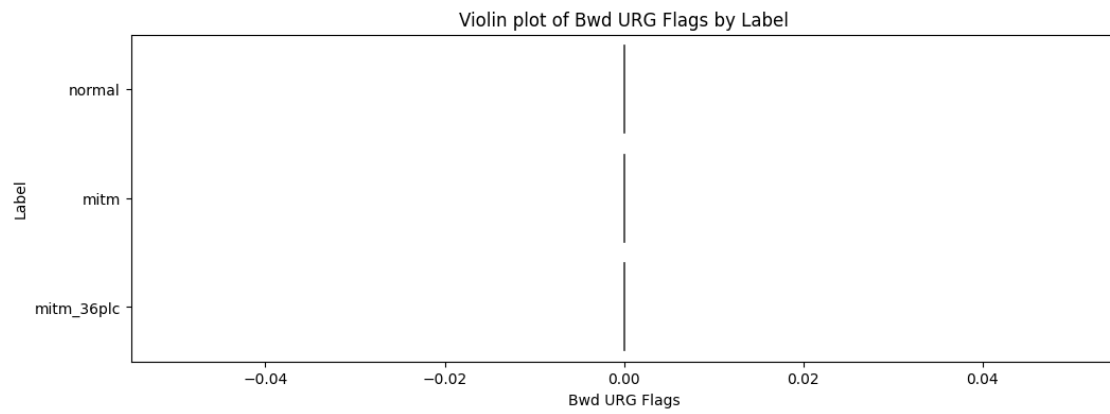
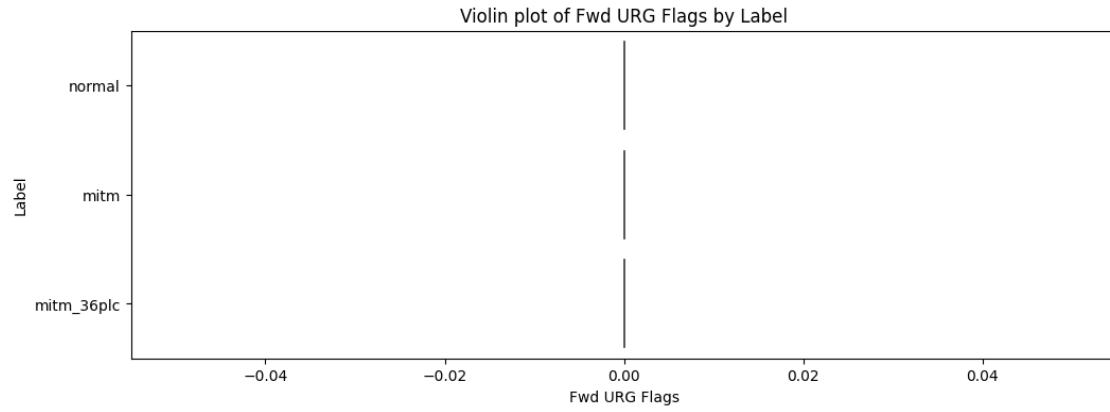


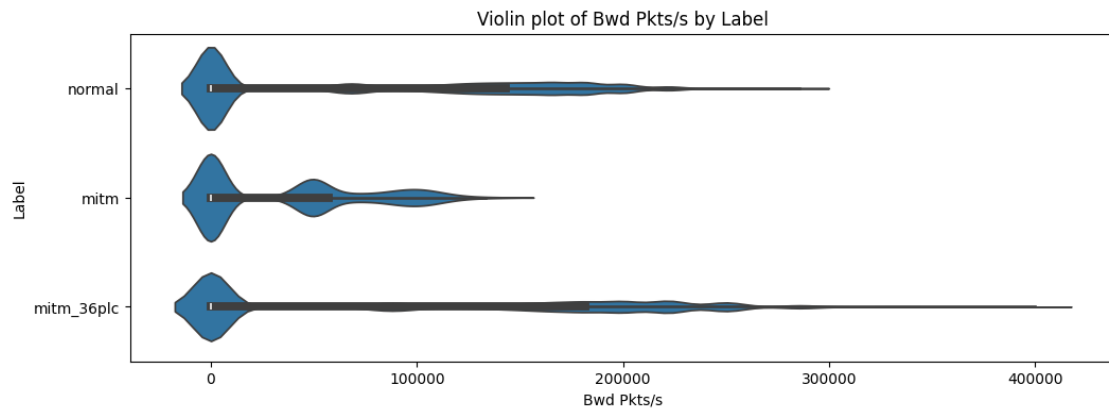
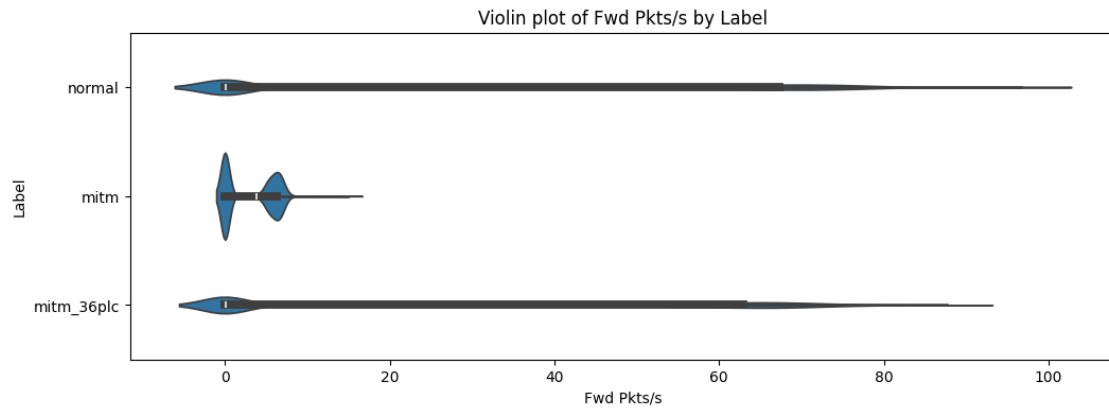
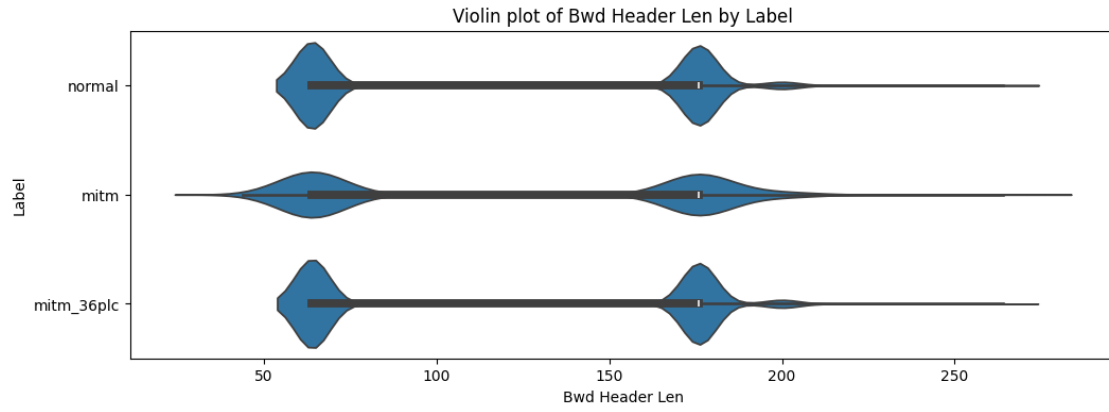


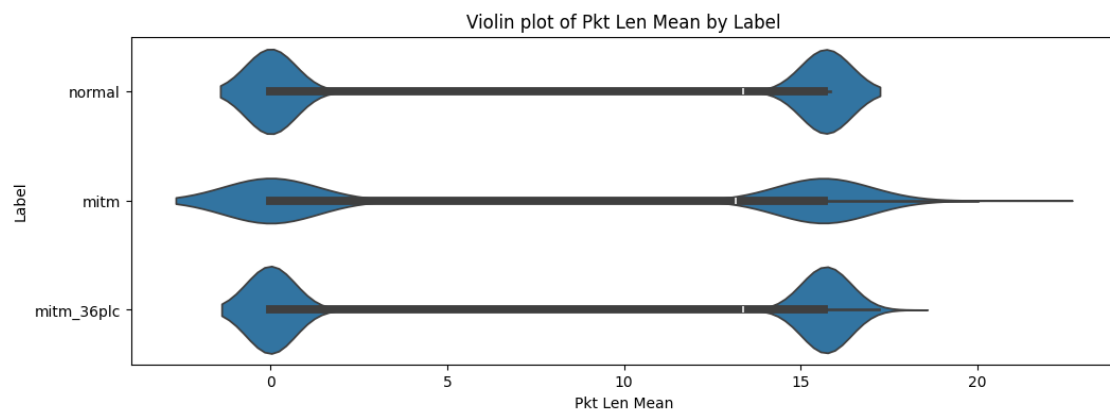
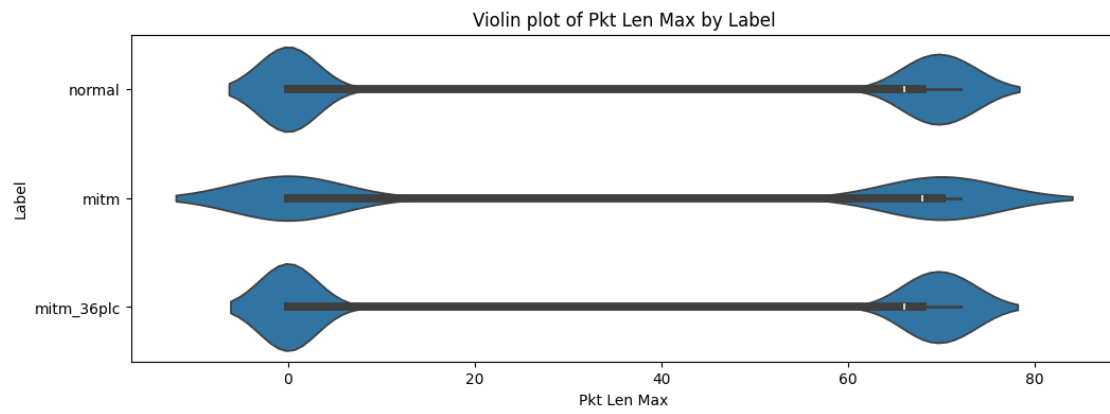
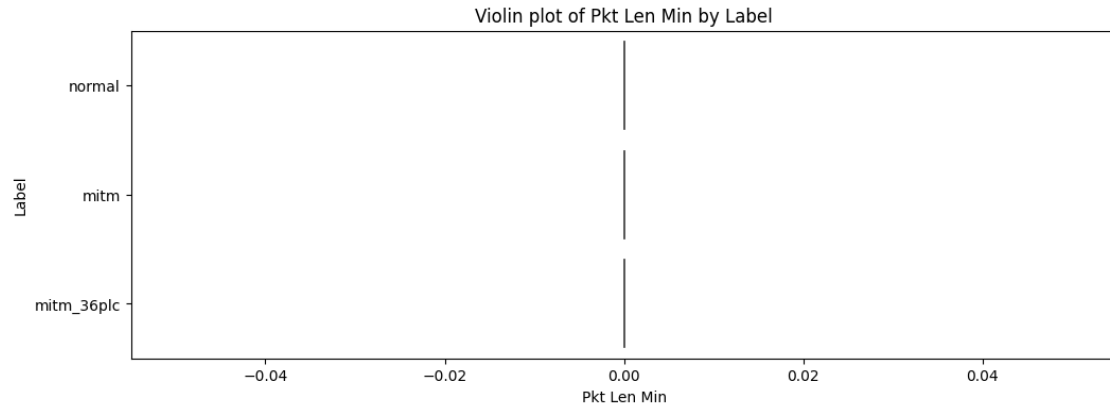


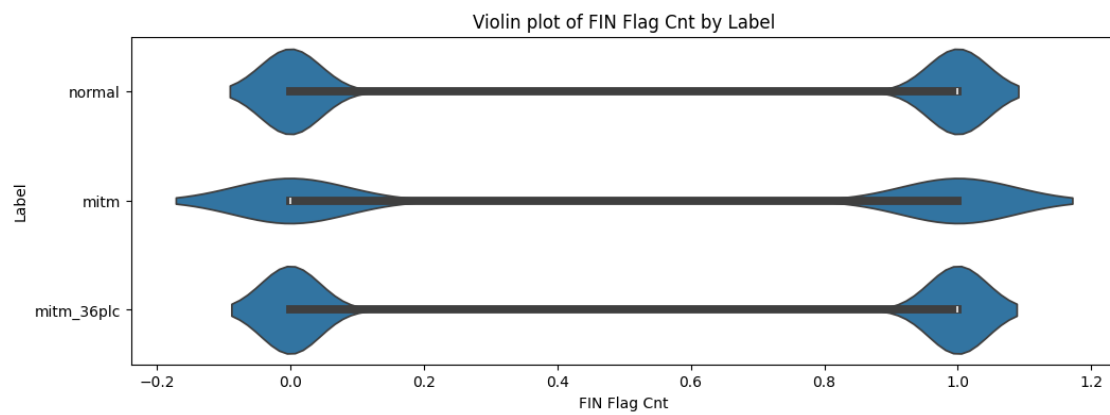
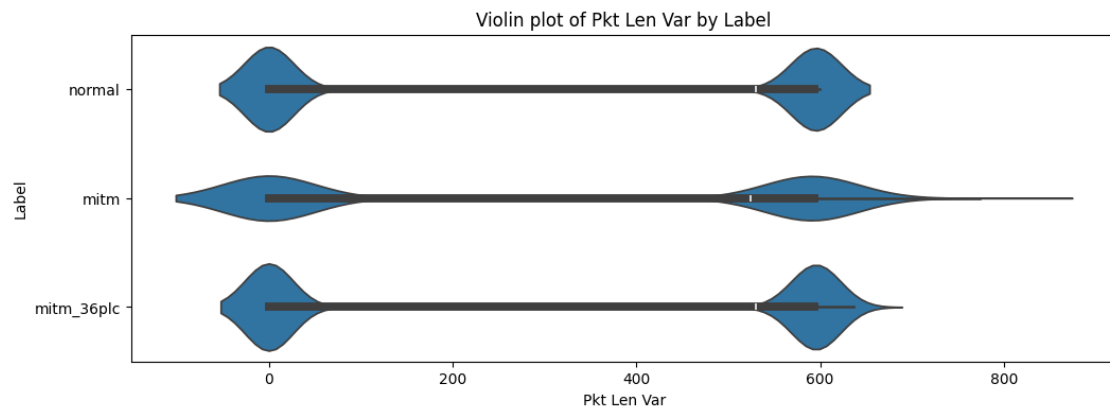
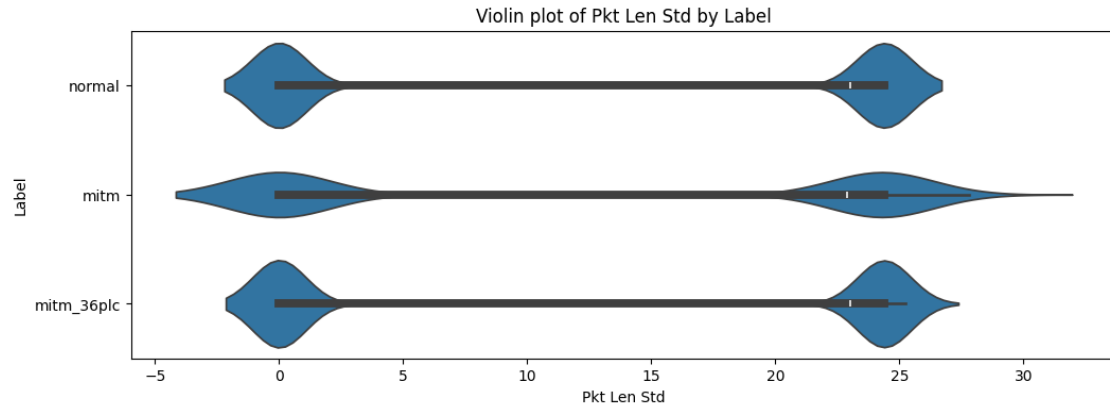


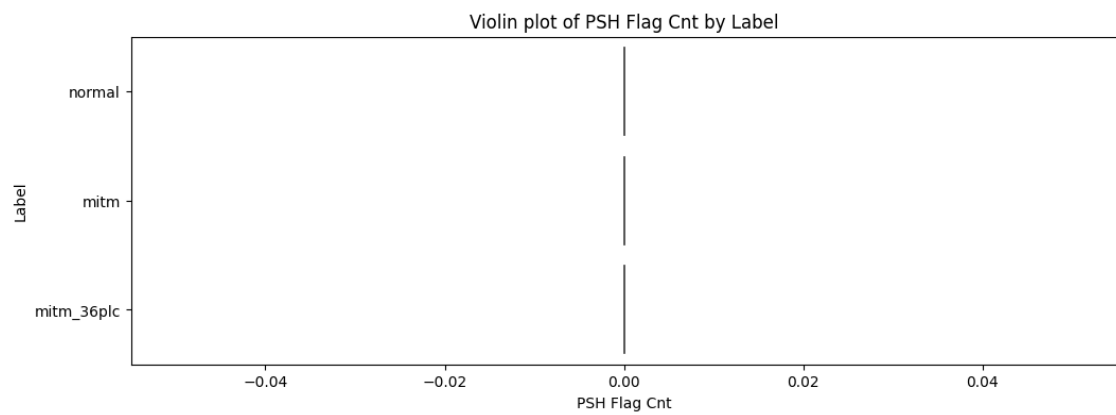
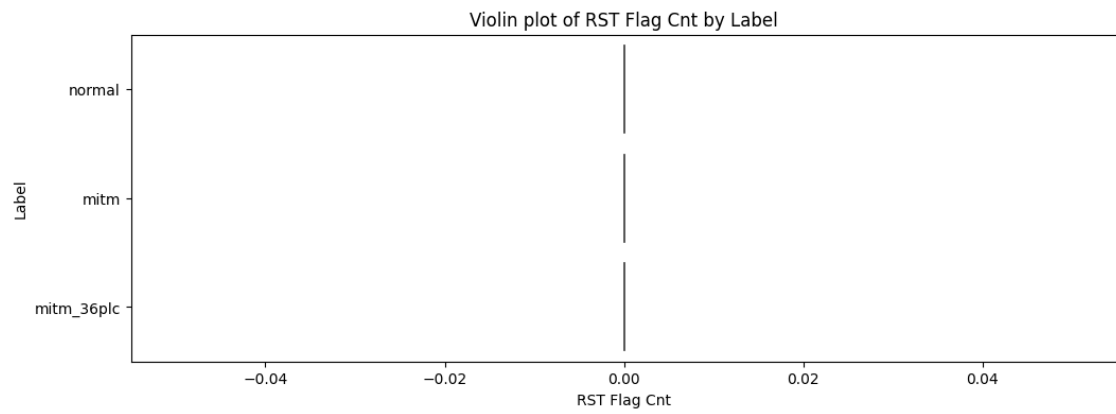
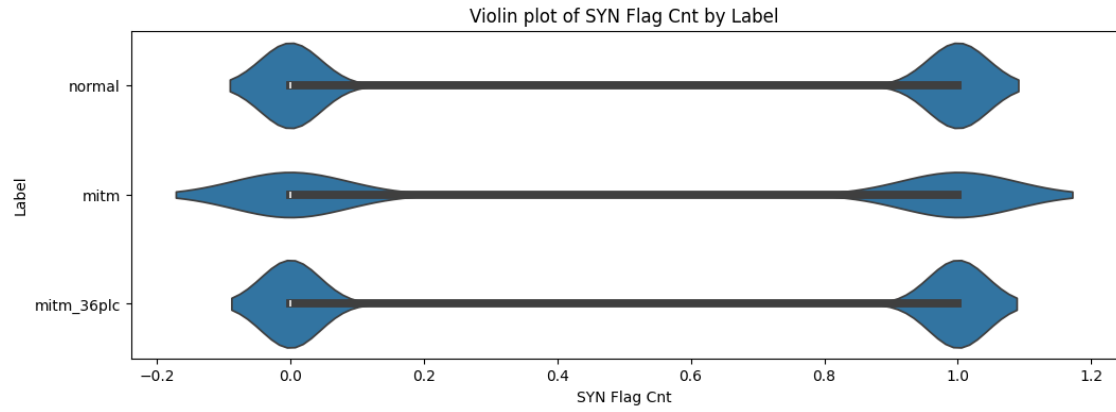


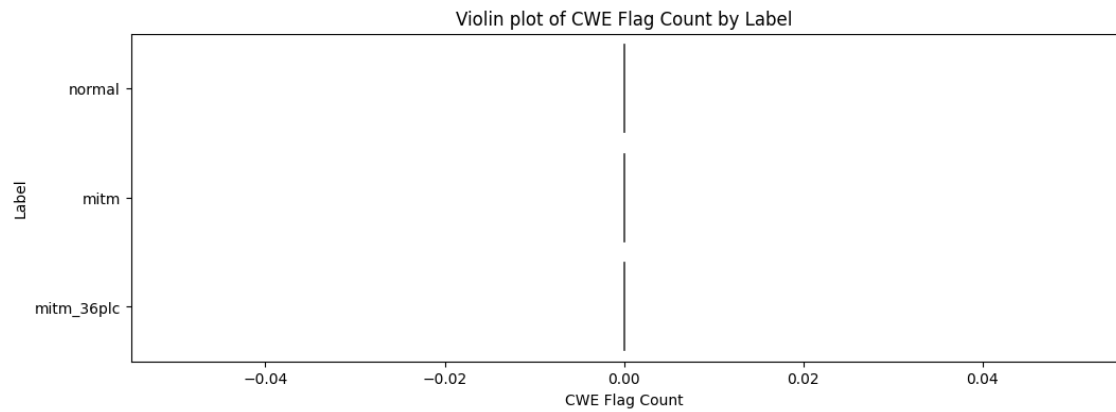
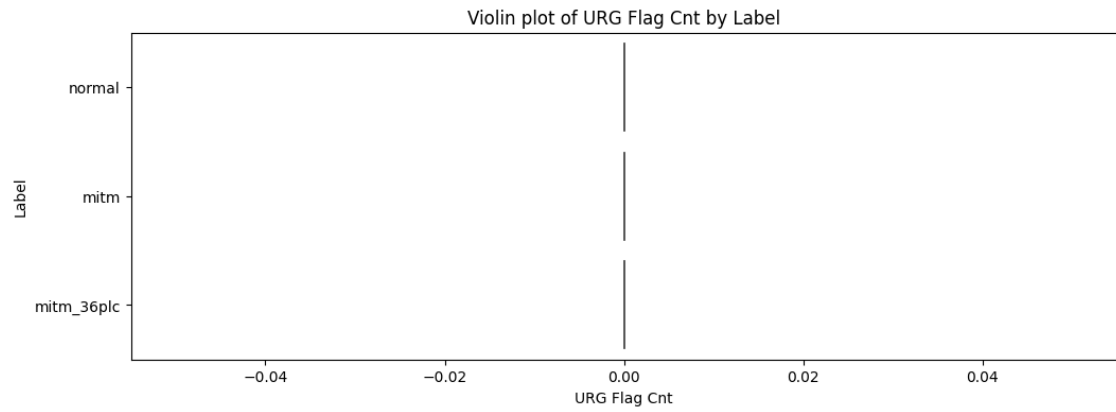
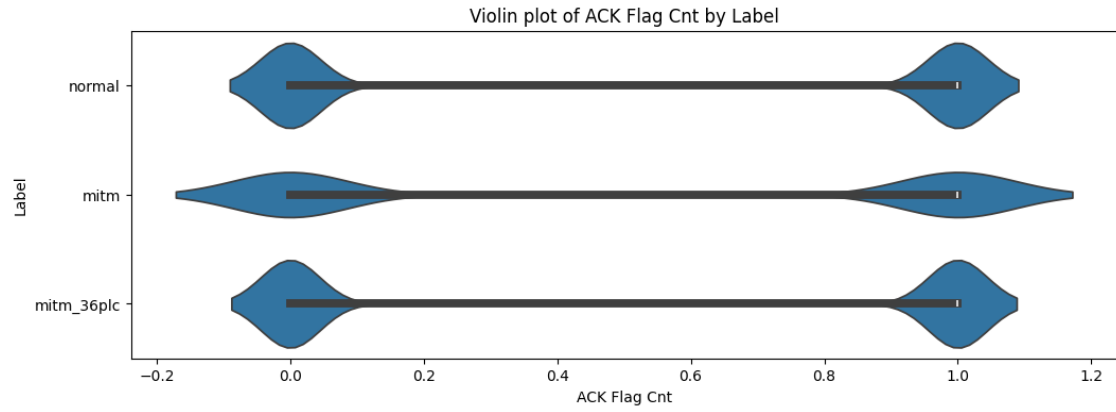


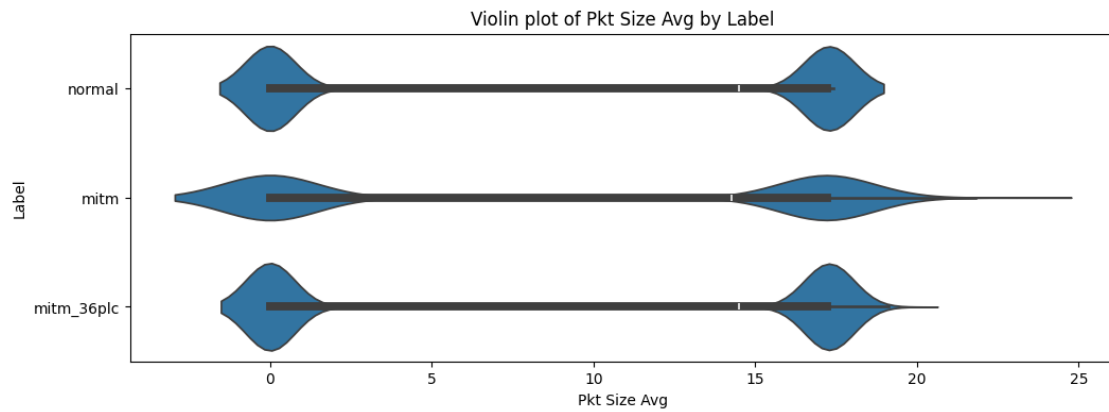
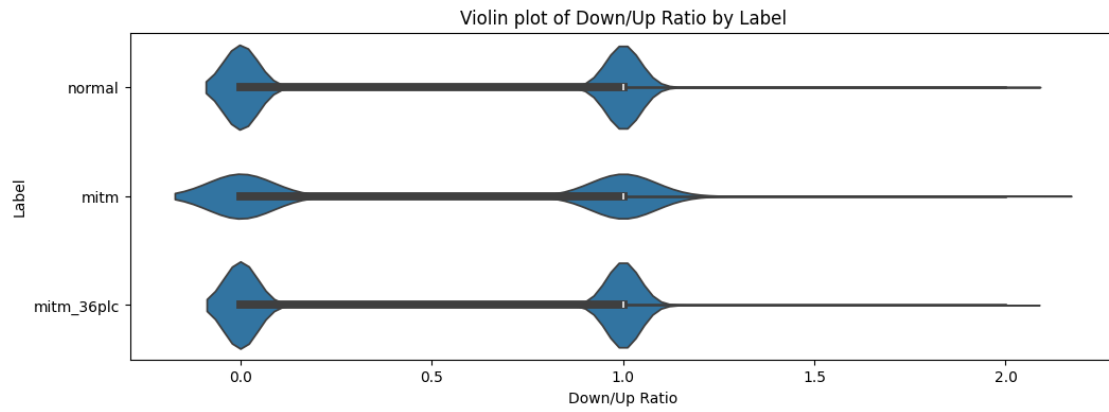
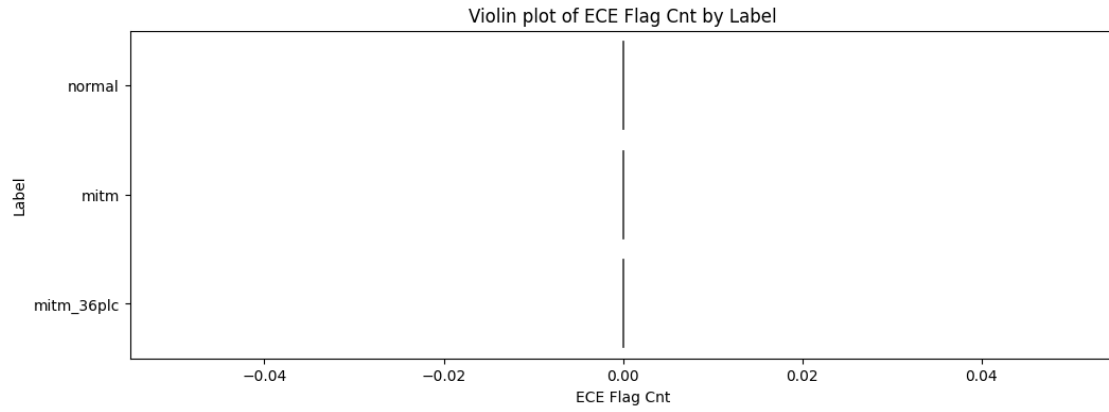


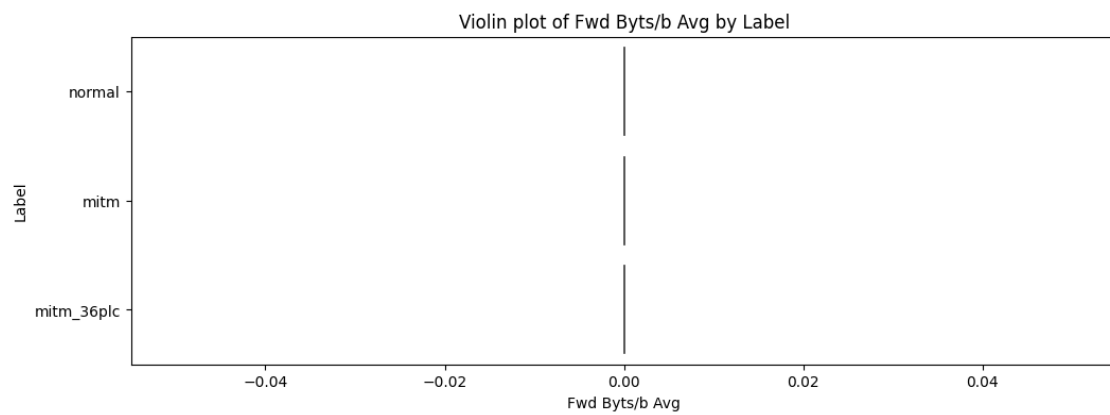
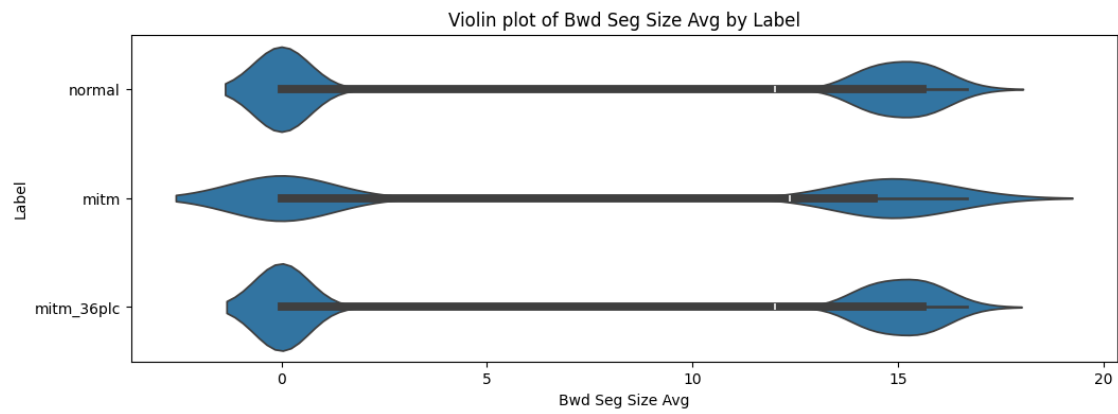


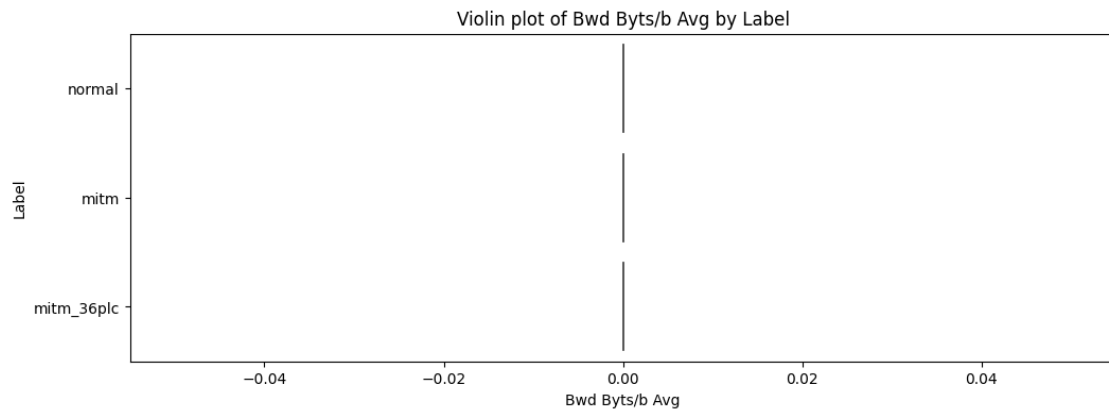
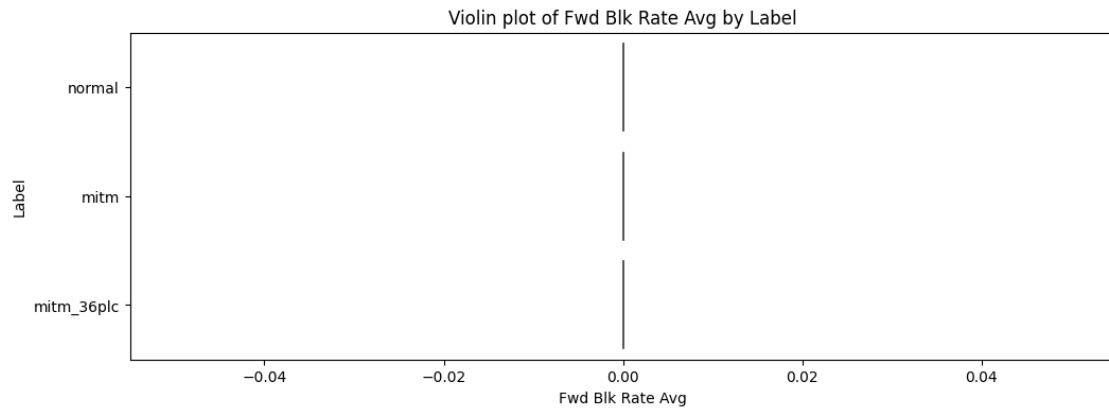
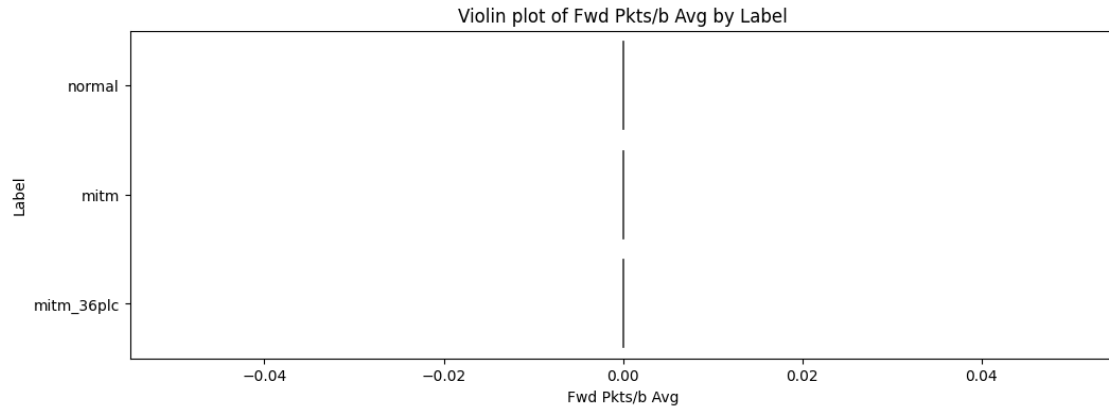


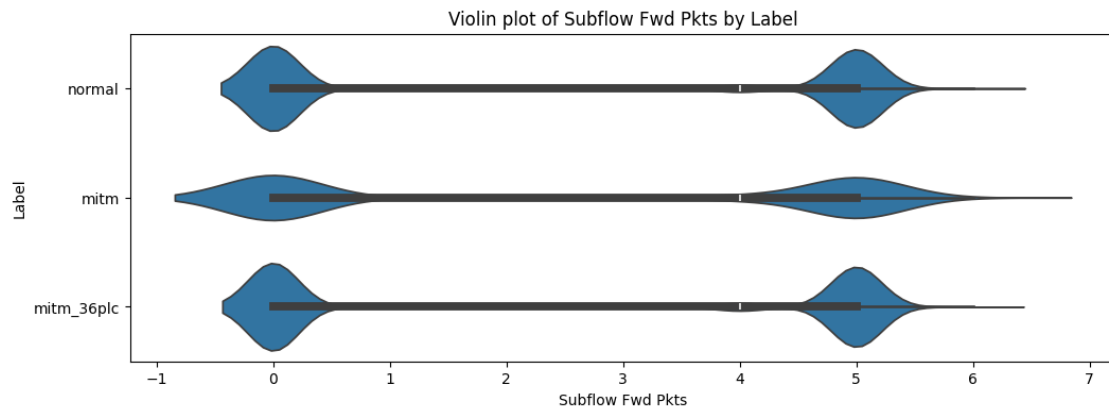
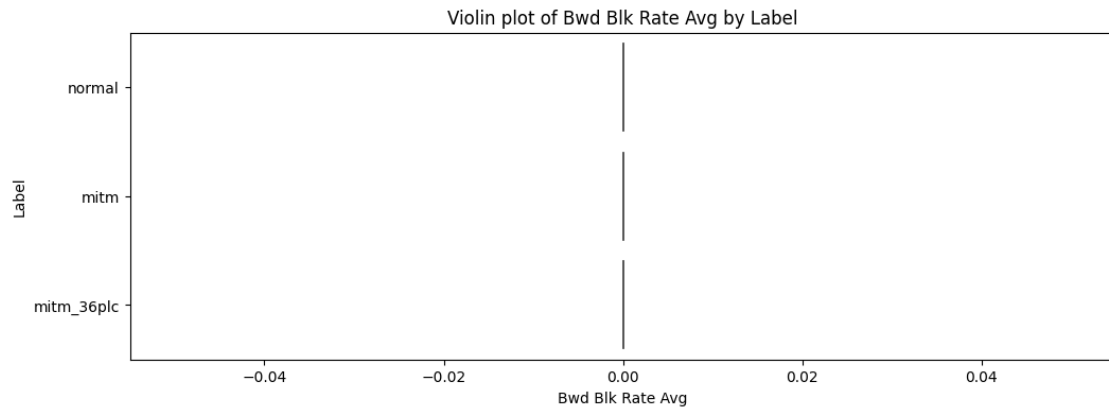
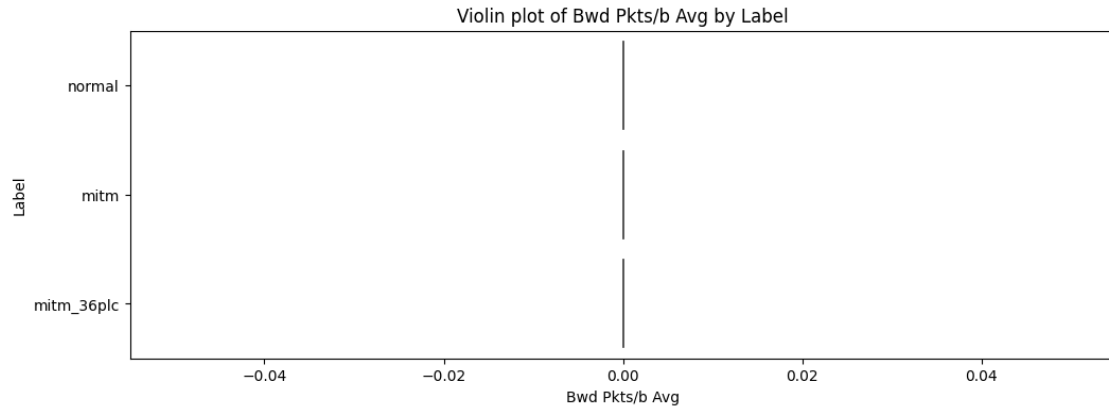


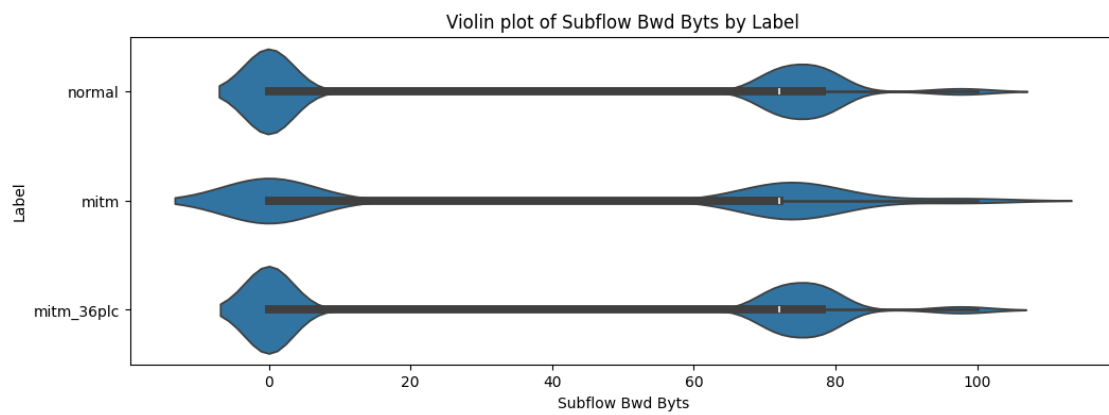
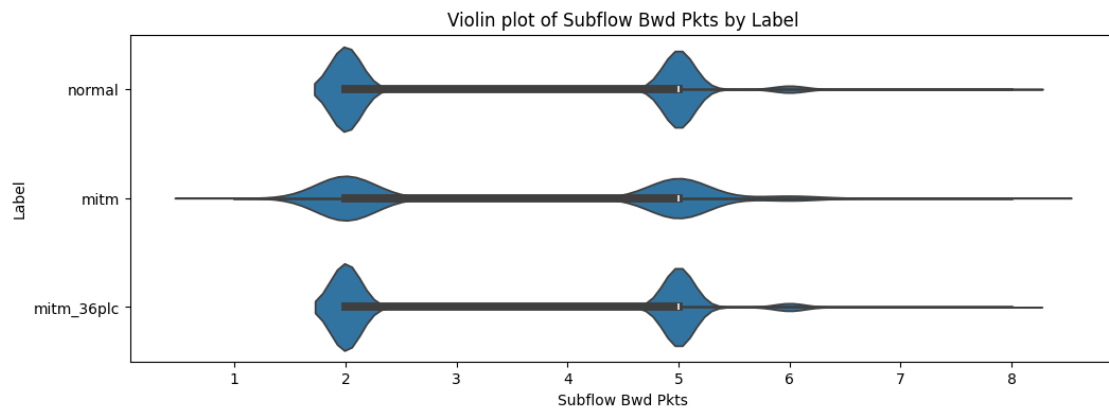
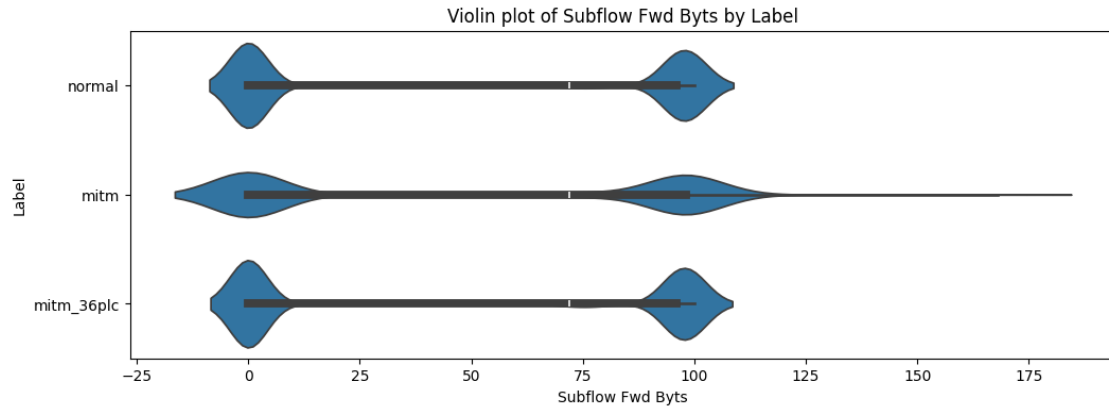


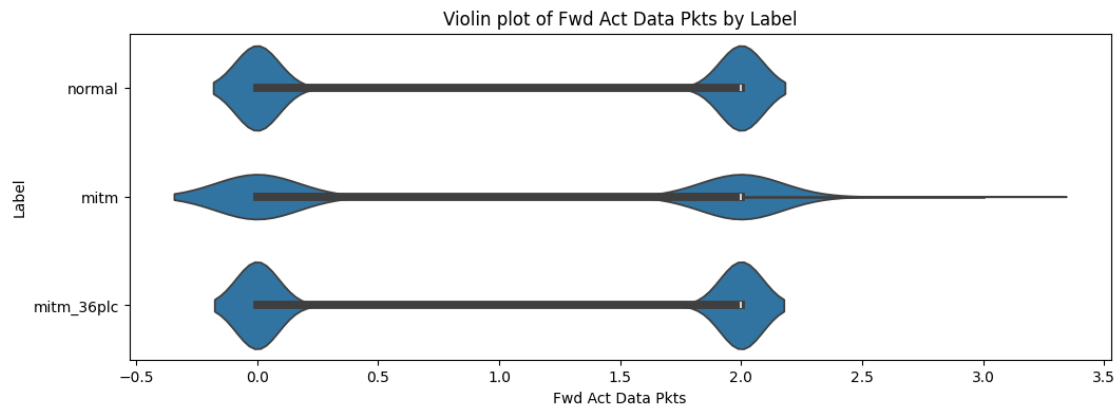
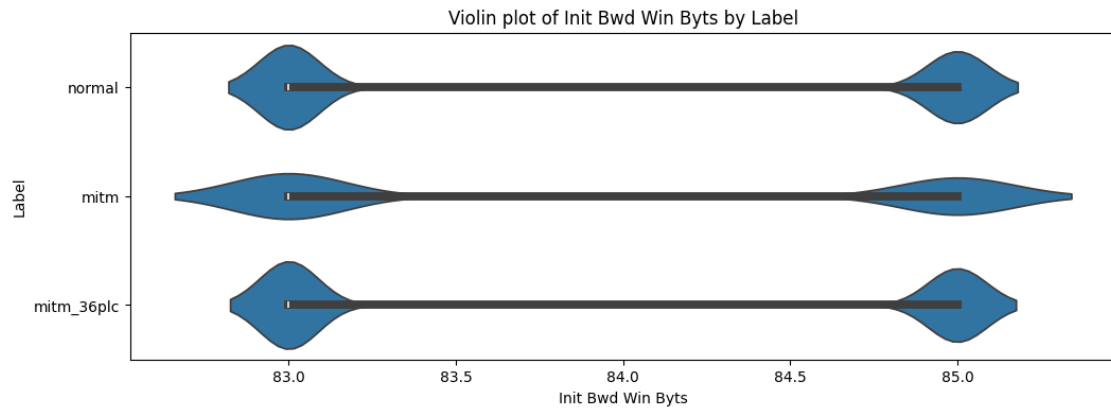
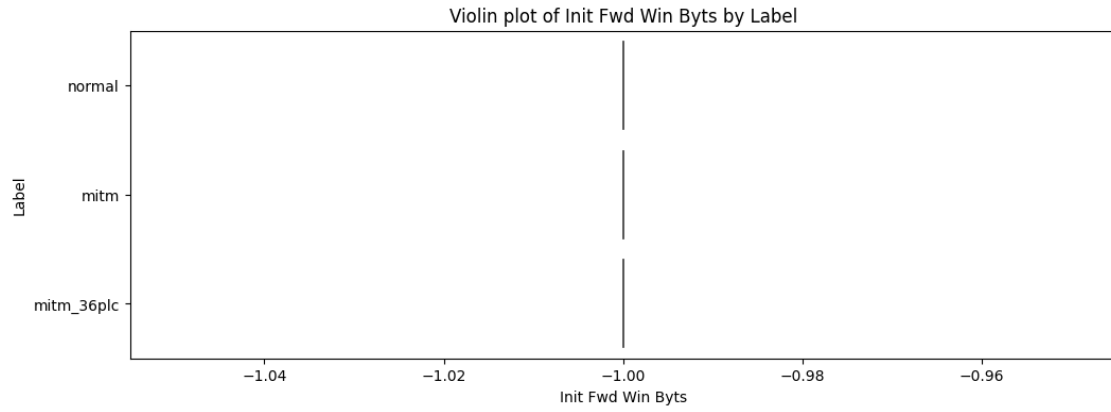


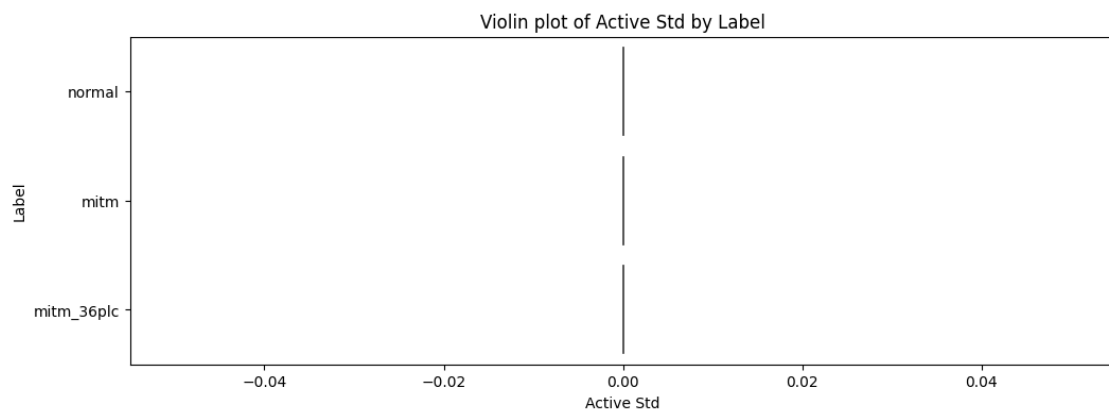
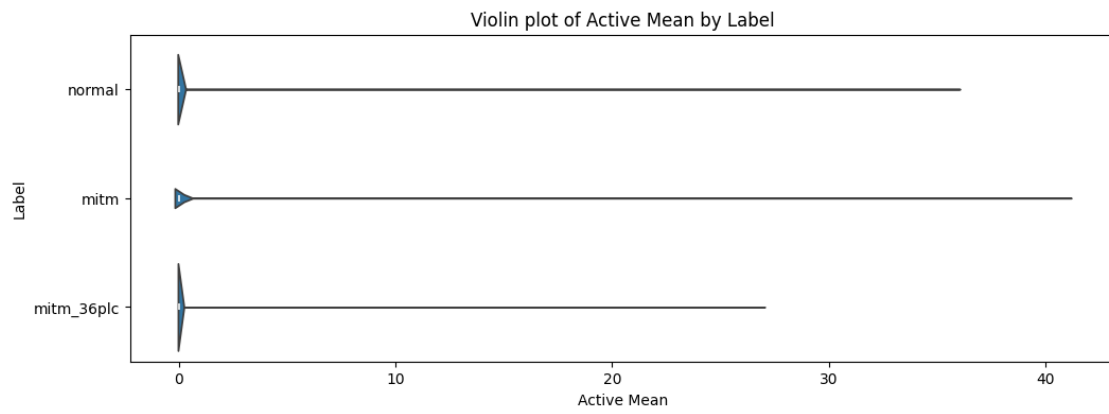
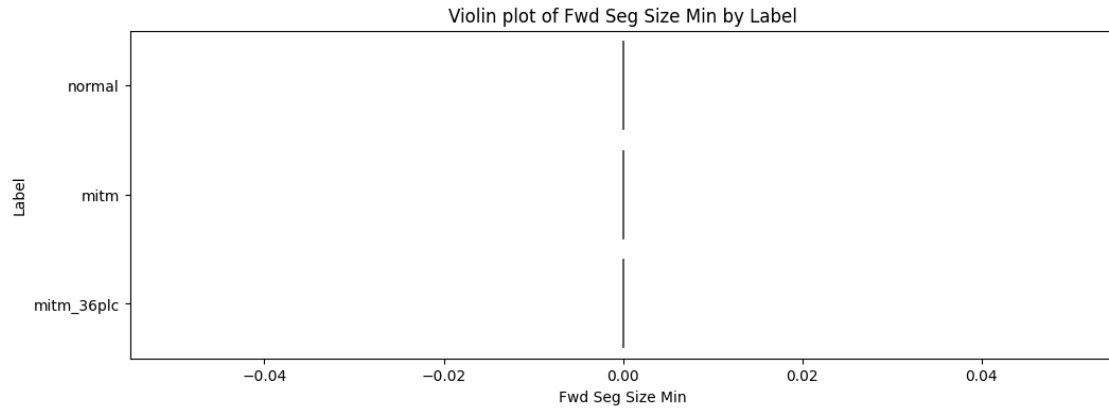


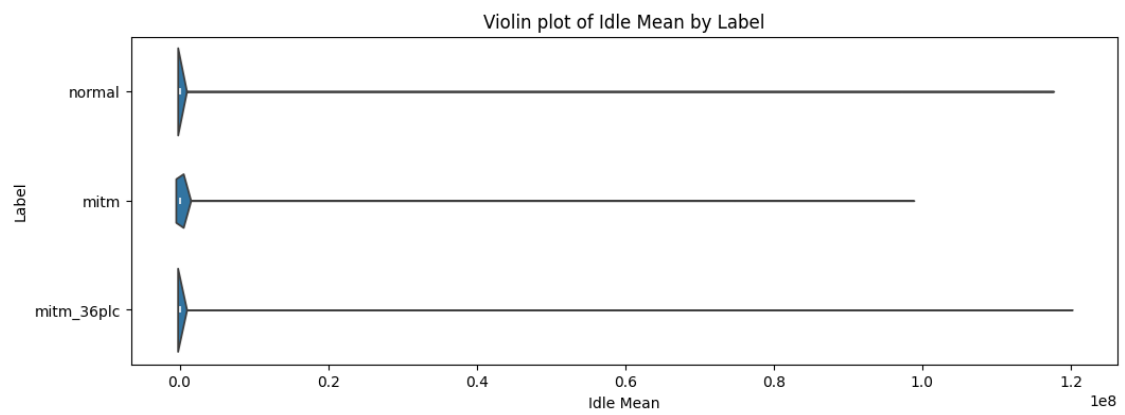
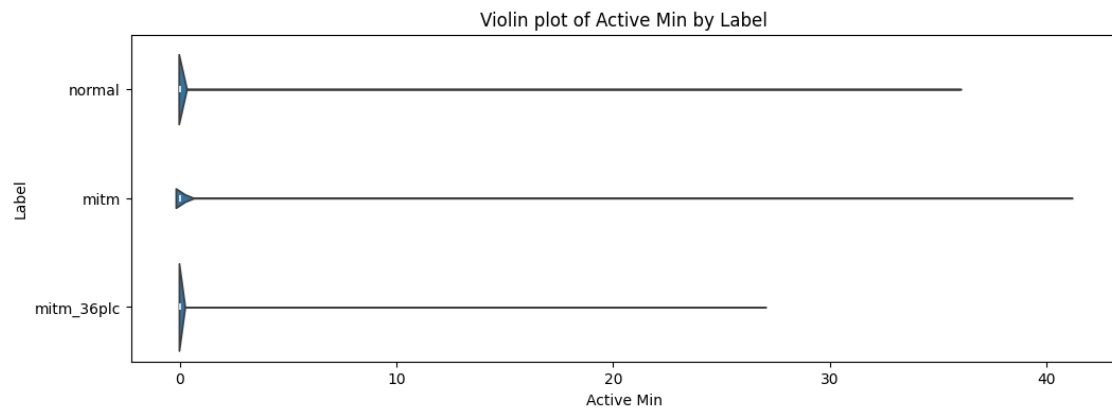
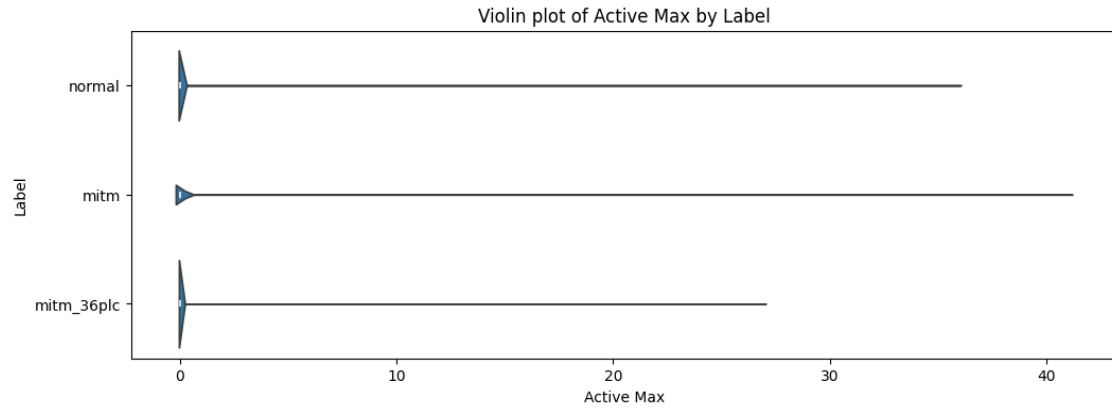


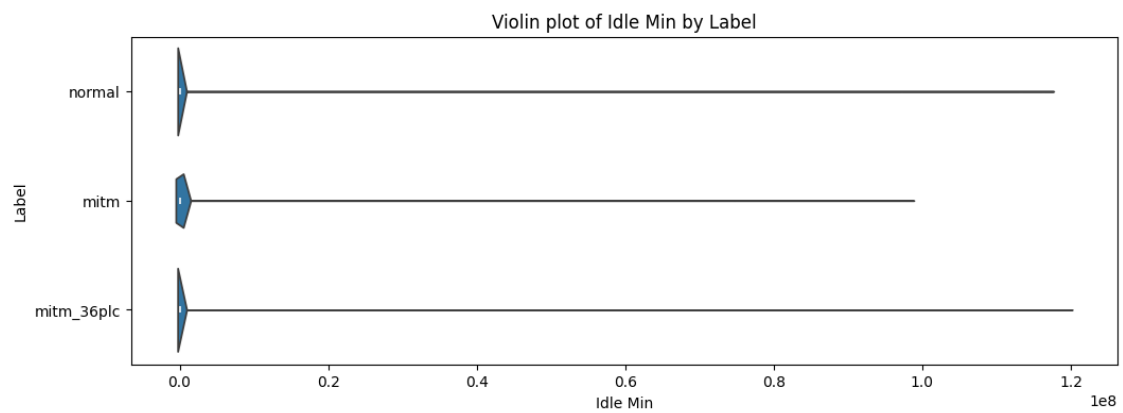
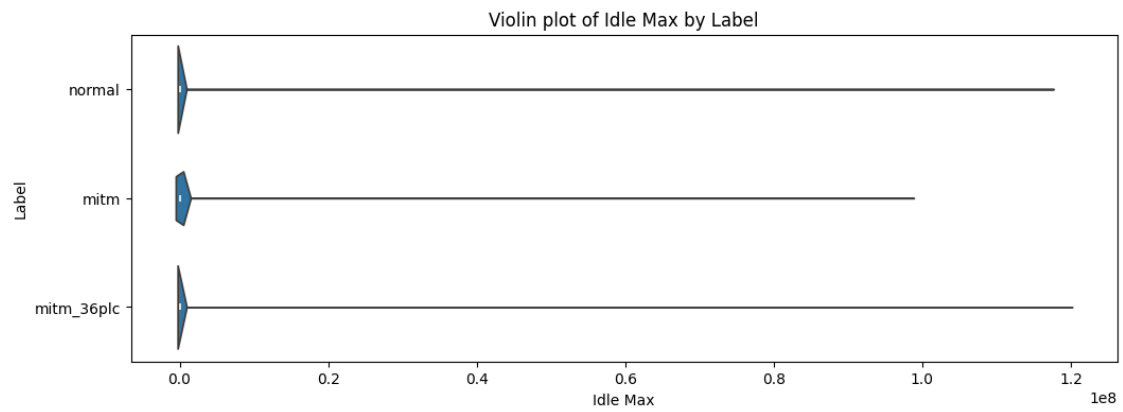
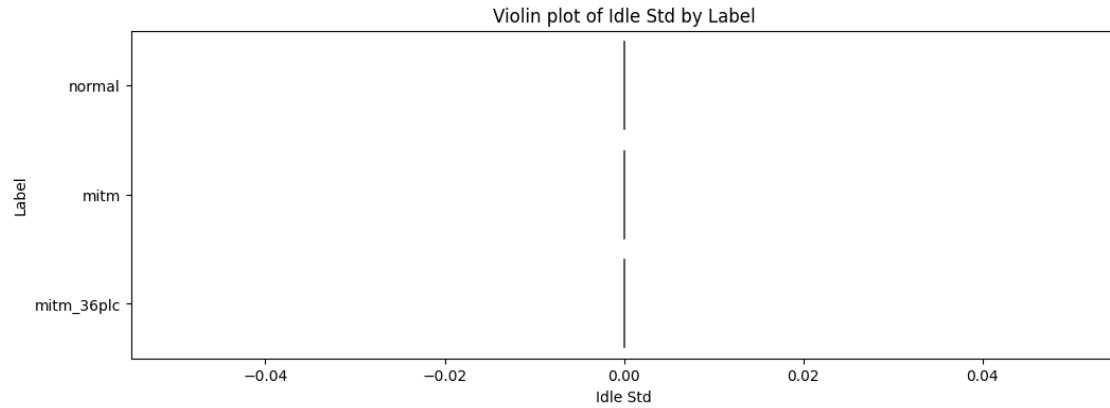












```
[33]: from scipy.stats import ttest_ind

label_values = df['Label'].unique()
```

```

group1 = df[df['Label'] == label_values[0]]
group2 = df[df['Label'] == label_values[1]]

for col in df.select_dtypes(include='number').columns:
    stat, p = ttest_ind(group1[col], group2[col], nan_policy='omit')
    print(f'{col}: t={stat:.2f}, p={p:.4f}')

```

```

Protocol: t=nan, p=nan
Flow Duration: t=-21.20, p=0.0000
Tot Fwd Pkts: t=0.35, p=0.7259
Tot Bwd Pkts: t=-0.60, p=0.5465
TotLen Fwd Pkts: t=0.32, p=0.7456
TotLen Bwd Pkts: t=0.40, p=0.6891
Fwd Pkt Len Max: t=0.53, p=0.5948
Fwd Pkt Len Min: t=nan, p=nan
Fwd Pkt Len Mean: t=-0.00, p=0.9984
Fwd Pkt Len Std: t=0.38, p=0.7070
Bwd Pkt Len Max: t=0.63, p=0.5314
Bwd Pkt Len Min: t=nan, p=nan
Bwd Pkt Len Mean: t=0.83, p=0.4080
Bwd Pkt Len Std: t=0.65, p=0.5180
Flow Byts/s: t=73.69, p=0.0000
Flow Pkts/s: t=37.37, p=0.0000
Flow IAT Mean: t=-25.84, p=0.0000
Flow IAT Std: t=-9.07, p=0.0000
Flow IAT Max: t=-6.88, p=0.0000
Flow IAT Min: t=-11.43, p=0.0000
Fwd IAT Tot: t=-316.62, p=0.0000
Fwd IAT Mean: t=-315.29, p=0.0000
Fwd IAT Std: t=-283.50, p=0.0000
Fwd IAT Max: t=-273.95, p=0.0000
Fwd IAT Min: t=-108.79, p=0.0000
Bwd IAT Tot: t=-21.18, p=0.0000
Bwd IAT Mean: t=-35.93, p=0.0000
Bwd IAT Std: t=-6.34, p=0.0000
Bwd IAT Max: t=-7.33, p=0.0000
Bwd IAT Min: t=-333.73, p=0.0000
Fwd PSH Flags: t=nan, p=nan
Bwd PSH Flags: t=nan, p=nan
Fwd URG Flags: t=nan, p=nan
Bwd URG Flags: t=nan, p=nan
Fwd Header Len: t=0.25, p=0.7998
Bwd Header Len: t=-0.40, p=0.6892
Fwd Pkts/s: t=73.45, p=0.0000
Bwd Pkts/s: t=37.32, p=0.0000
Pkt Len Min: t=nan, p=nan
Pkt Len Max: t=-0.26, p=0.7954
Pkt Len Mean: t=0.37, p=0.7113

```

```

Pkt Len Std: t=0.28, p=0.7759
Pkt Len Var: t=0.57, p=0.5680
FIN Flag Cnt: t=0.06, p=0.9483
SYN Flag Cnt: t=0.01, p=0.9946
RST Flag Cnt: t=nan, p=nan
PSH Flag Cnt: t=nan, p=nan
ACK Flag Cnt: t=-0.01, p=0.9946
URG Flag Cnt: t=nan, p=nan
CWE Flag Count: t=nan, p=nan
ECE Flag Cnt: t=nan, p=nan
Down/Up Ratio: t=-0.03, p=0.9793
Pkt Size Avg: t=0.37, p=0.7107
Fwd Seg Size Avg: t=-0.00, p=0.9984
Bwd Seg Size Avg: t=0.83, p=0.4080
Fwd Byts/b Avg: t=nan, p=nan
Fwd Pkts/b Avg: t=nan, p=nan
Fwd Blk Rate Avg: t=nan, p=nan
Bwd Byts/b Avg: t=nan, p=nan
Bwd Pkts/b Avg: t=nan, p=nan
Bwd Blk Rate Avg: t=nan, p=nan
Subflow Fwd Pkts: t=0.35, p=0.7259
Subflow Fwd Byts: t=0.32, p=0.7456
Subflow Bwd Pkts: t=-0.60, p=0.5465
Subflow Bwd Byts: t=0.40, p=0.6891
Init Fwd Win Byts: t=nan, p=nan
Init Bwd Win Byts: t=1.83, p=0.0675
Fwd Act Data Pkts: t=-0.04, p=0.9661
Fwd Seg Size Min: t=nan, p=nan
Active Mean: t=-1.34, p=0.1815
Active Std: t=nan, p=nan
Active Max: t=-1.34, p=0.1815
Active Min: t=-1.34, p=0.1815
Idle Mean: t=-0.29, p=0.7725
Idle Std: t=nan, p=nan
Idle Max: t=-0.29, p=0.7725
Idle Min: t=-0.29, p=0.7725

```

```

/home/ics-security/anaconda3/envs/DATN/lib/python3.9/site-
packages/scipy/stats/_axis_nan_policy.py:531: RuntimeWarning: Precision loss
occurred in moment calculation due to catastrophic cancellation. This occurs
when the data are nearly identical. Results may be unreliable.

```

```

res = hypotest_fun_out(*samples, **kwargs)

```

```

[ ]: # from sklearn.preprocessing import LabelEncoder

# # Create and fit the encoder
# le = LabelEncoder()
# df['Label_encoded'] = le.fit_transform(df['Label'])

```

```
# # Create mapping dictionary
# label_mapping = dict(zip(le.classes_, le.transform(le.classes_)))

# print("Label to Integer Mapping:")
# for label, code in label_mapping.items():
#     print(f"'{label}' → {code}")
```

Label to Integer Mapping:

```
'mitm' → 0
'mitm_36plc' → 1
'normal' → 2
```

```
[ ]: # reverse_mapping = dict(zip(le.transform(le.classes_), le.classes_))

# print("\nInteger to Label Mapping:")
# for code, label in reverse_mapping.items():
#     print(f"{code} → '{label}'")
```

Integer to Label Mapping:

```
0 → 'mitm'
1 → 'mitm_36plc'
2 → 'normal'
```

```
[ ]:
```